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Forthcoming Events.

OCTOBER 24.

Institution of British Foundrymen (Sheffield and District Branch):—Joint visit to Sheepbridge Coal & Iron Company, Chesterfield. A talk on blast furnace practice.

North of England Institute of Mining and Mechanical Engineers:—General meeting at Newcastle-on-Tyne.

OCTOBER 27.

Association of Drop Forgers and Stampers:—Lecture at Birmingham on "Remarks on Drop Forging Equipment," by Bernard Brett.

OCTOBER 27 TO NOVEMBER 7.

Commercial Motor Transport Exhibition:—Olympia, London.

OCTOBER 29.

Institution of Locomotive Engineers:—General meeting in London. Presidential address by R. W. Reid, C.B.E.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

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Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.

Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Cast Iron—The Mystery Alloy.

A recent meeting of the Junior Institution of Engineers was devoted to the discussion of questions raised by members who had problems that needed solution. According to a report circulated to the Press, one query was "whether cast iron could fail owing to fatigue. A broken propeller blade was specially referred to. It appeared that no information had been found on the subject, and yet such a theory seemed to supply an answer to several otherwise unexplained failures." That engineers are unaware of the nature of cast iron is not entirely their fault. The people who make it should, in fact must, carry out propaganda. We are sorry to think that engineers have taken away with them the impression that propeller failures are due to fatigue. We would recommend them to study Mr. H. J. Young's paper on "Marine Engine Castings," read before the Institute of Marine Engineers, wherein a diagram appears of a propeller blade and inset is the microstructure to be associated with each particular thickness under normal but obviously different cooling conditions. As is well known, foundrymen are tackling this problem of ensuring uniform material throughout a casting energetically, and the problem is how to ensure that this information reaches the engineer-users.

A system of exchanging information has been successfully developed between the Institute of British Foundrymen and the Associations of America, France and Belgium by means of "Exchange papers." From the above quotation it seems that there is a greater need for Exchange papers between British engineering societies and the Institute of British Foundrymen. Mr. Hoblyn, of the Vauxhall Company, has done much useful work in this direction. He has given the foundrymen the benefit of his experience derived from the critical reception of iron castings. The drop-forgers have had a similar discourse. Mr. P. Pritchard, of the Midland Motor Cylinder Company, has put forward the foundryman's viewpoint to many branches of the Institution of Automobile Engineers. These excellent papers are, however, just unconnected pieces of personal work, and can never replace annual systematic reciprocal papers carrying the weight of a national organisation.

A second method, which has been proved to be a success, is the holding of meetings for the mutual discussion of common problems. The one held in Glasgow between the local branch of the Institute of British Foundrymen and those interested in Diesel engines was of first-rate importance. The metallurgical societies are already collaborating systematically to undoubted mutual benefit. There is no technical society which is connected with engineering, even though but remotely, which would not benefit from a regular exchange of thoughts with the foundrymen. We do not believe that there would be the slightest difficulty in finding suitable lecturers, or for the arranging of joint meetings. The founders cannot hope to extend the use of their product unless engineers are made to realise the potentiality of cast iron, especially the material coming under the general designation of "high duty" cast iron.

XUM

Institute of British Foundrymen.

LANCASHIRE BRANCH.

FOUNDRY WASTERS.

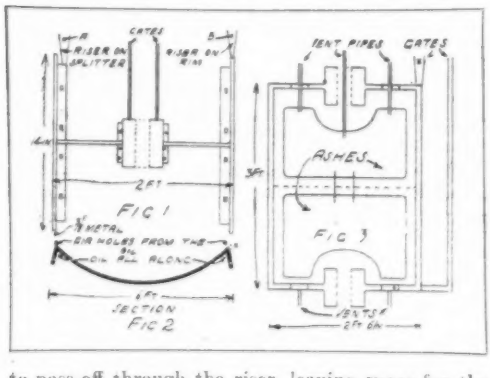
MR. A. SUTCLIFFE, in opening a discussion upon foundry wasters, said waster castings were produced, more or less, in all foundries. Sometimes the fault lay with the management, but in other cases they occurred because the foreman or supervisor insisted upon having his own way and was not willing to learn from the experience of others. It ought to be realised that all the brains were not under one hat. If a defect was discovered in the first casting, immediately it was made, another method might be tried, and perhaps the fault would be rectified, but when the larger part or the whole of an order had been completed before the machining of the castings, it was too late to amend. On this occasion he proposed to deal with a number of waster castings which had come under his personal observation, in the course of his own work or at the foundries of firms outside. Mr. Sutcliffe proceeded to describe a number of jobs by means of diagrams.

Branch Pipes.

In this case a branch was "drawn," a defect which would have been avoided if the branch had been at the bottom. It was, in fact, at the top. The top box was a hindrance, so far as the bars were concerned, and there was a difficulty in putting the cake on. In his opinion, the branch should be put at the bottom and covered up with the cake; it was much cheaper and took less time.

Pulley.

He advocated making this casting (Fig. 1) with a riser or whistler so as to allow the gas in the rim



to pass off through the riser, leaving space for the metal. The first moulder had his riser from the splitter A and made a bad casting. The second moulder had his riser from the rim B and made a good casting.

Keir Plate.

Trouble in this case (Fig. 2) was caused by the wrong use of the oil can. The oil became intermixed and produced a quantity of air which was driven out at the top, and the casting became blown or contained air bubbles.

Drum.

This casting (Fig. 3) was made from an oil sand core and the runner was at the top and the bottom. The top runner was covered with a stopper, which was lifted after the mould was about three parts full. The first casting was faulty, because the gas could not get away freely from the oil sand cores. Some moulders thought no gas should be evolved from an oil sand core, but he disagreed entirely. The gas should be able to get away quite freely. In the second case the same running was adopted and the second casting was as near perfection as possible, and machined up on the face quite cleanly. There was no difference in the moulding or core making, only the choking of the vents with wet parting sand and the iron tubes.

Planing Machine Table.

This casting weighed 8 tons, and for making it the metal was run at both ends, and when the two streams met in the middle, a scum was caused. In his opinion, that was due to the metal from one of the ladles not being sufficiently hot, the effect being that the streams of metal failed to knit together properly on contact. When running at both ends the metal must always be sufficiently hot to knit together in the centre. This casting was made with the T-slots uppermost. He claimed that this was the wrong way, as they should be in the bottom. In his opinion, that had some connection with the appearance of scum at the junction of the two metals.

Nine-Ton Headstock.

The casting, which weighed 9 tons, was made upside down, and the dome core at the bottom was vented by means of cinders, and the presence of these cinders was not made known to the moulders, the result being that they made no provision for evacuating the gas from this particular core, so that when it was cast, some metal—about 3 cwt.—was ejected. For any cinder-vented core the moulder must provide some means for getting away the contained air. This is still true for a small vent in a round or square core.

Steam Chest.

This casting was 10 ft. by 4 ft., and weighed 30 cwt. The cores were held up by pieces of scrap iron. The defect in this case was that the metal

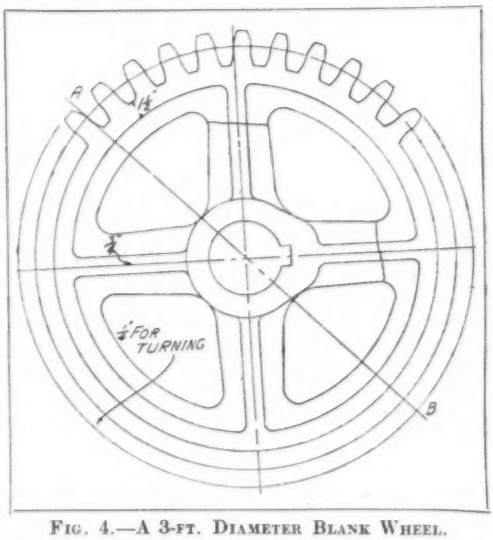


FIG. 4.—A 3-FT. DIAMETER BLANK WHEEL.
Pitch 1⅞ ins., depth of teeth 6¾ ins. thickness of rim ⅞ in.

was porous around the scrap iron and would not withstand pressure.

Blank Wheel.

The mould for this casting (Fig. 4) was not quite as shown, as the mould was 1½ in. from the root of the tooth to the back of the core, which was out of proportion, as the wheel was 1¾ in. pitch. He claimed that in this case the faulty casting was due to the drawing office, as the casting cracked in dressing, after being in the dressing shop two days. He would like to hear what some draughtsman had to say about that.

MR. HAIGH said the human element was a factor of considerable importance in the production of faulty castings, many being due to sheer carelessness. He was not, however, in entire agreement with Mr. Sutcliffe. The position of the branches on pipes was not always a matter left to the discretion of the foundryman; he had to work to his instructions and drawings, and pipes had to be made with branches at the top and sides as well as at the bottom. He saw no reason for preferring the branches at the bottom; in his opinion, the castings could be equally well made with the branches at the top. In the case of the pulley, he saw no necessity for using a riser.

For cylindrical castings to be machined, such as the drum Mr. Sutcliffe had described, he advocated running at the top whenever possible.

Dealing with tank plates, Mr. Haigh described a case of moulding a plate 12 ft. by 5 ft. by ¾ in. thick. No gaggers were used in the top part.

Mr. R. A. Miles observed that he did not believe in putting a riser on a pulley of that type.

Mr. Sutcliffe remarked that he had a fairly extensive experience of making pipes, sometimes 100 in a week, of all sizes up to 30 in., and he was unshaken in his conviction that it was better to cast pipes with the branches at the bottom. He had in his employ a man who could turn out the job quicker and better than any man who adopted casting branches at the top. Take the case of a 4-in. pipe carrying a branch 13 in. long. Dealing with it in the way Mr. Haigh approved, it would project through the top box many inches and if on the side would require a box 20 in. wide. If the branch was on the bottom, the top box would only require to be an ordinary pipe top box 10 in. wide.

If the pulley was made without a riser or a whistler, three out of every four would be faulty. In regard to the difference of opinion as to the running in the case of the drum, Mr. Haigh's reference to "pellety" metal was significant. The casting referred to on machining proved to be a good, sound, clean one.

Mr. A. L. Key said when a lecturer was describing the method he followed, it was easy to criticise, but to anyone who had travelled about the country it must be evident that the practice varied in different districts and processes had to be modified to suit local conditions and temperament. He had seen things carried out with success which, if attempted in another district, would have resulted in waster castings. An illustration of what he had in mind was furnished by the pulley. Mr. Sutcliffe's experience was that he could not get that job done satisfactorily except by using a riser, but certainly the job could be done without it, everything depending on local conditions of sand and the ramming.

Referring to the planing machine table, he did not think anyone who was conversant with the action of metal would dispute that the metal further away from the centre was the cleanest, and he attributed the trouble Mr. Sutcliffe experienced to the two streams of metal not having knit together properly. Each stream probably carried with it a certain portion of dust or dirt, and when they met a scum was formed. That could be avoided by proper melting. For many years he had studied the action of metal, and his experience was that there was nothing to fear from two streams of metal if reasonable care was taken.

Mr. S. G. Smith said there were a variety of ways of doing a thing wrongly, and sometimes there was more than one way of doing it right; it did not necessarily follow because the practice of two men differed that one of them was mistaken. The pulley which had been under discussion was a case in point. Some recommended that it should be made with a riser, whilst others maintained the contrary. Both sides could put forward good arguments, and he was inclined to agree with both. The function of the riser was to get the air away from the mould.

Comparing bottom-running with top-running, it was a point against the latter that if the depth was great, there was a considerable splash which formed a shower of shot. But that was the only feature in favour of bottom-running, and after experience in the casting of thousands and thousands of tubes of various kinds, he preferred running at the top. Mr. Sutcliffe had said he could produce a man who would make pipes with bottom branches quicker and better than any man could make pipes with top branches. His (Mr. Smith's) reply to that was that he could produce a man who would make pipes with top branches quicker and better than anyone would make pipes with bottom branches.

CORE AND MOULD DRYING.

Mr. W. H. Meadowcroft, in a short paper under this title, said the question of core drying was a very important part of foundry practice. Serious losses were incurred by imperfectly dried cores, and besides the loss of castings, the safety of the workman was endangered by ejections of molten metal occurring through this cause. Trouble arose when cores and moulds which had been overheated in drying were unable to stand up to the heat and pressure of the molten metal.

In recent years great changes had taken place in the methods and materials for core making, and the use of silica sand, in conjunction with the various binders, had intensified the drying problem. Without efficient drying apparatus the full benefit of these new methods could not be obtained. It should be simple in working and capable of being maintained at the correct drying temperature of the particular material used; it was essential that the size and shape of the drying chamber should be suitable for the work. In the average foundry the core stove was often too large and of the wrong shape, many having been built very high on the off-chance of having a tall mould or core some day. This meant that the heat above could not be utilised. With one or more open fires these stoves developed a quick, fierce heat, which meant a large fuel consumption and very erratic temperatures over the drying period, and these factors, combined with poor circulation of air, yielded poor results. When there was a steady circulation of air to carry off the moisture as it was released from the cores or moulds much less fuel was required and the cores were more sound and reliable.

The question of atmosphere circulation had an important bearing on successful drying, and in this connection he had recently experimented. Some of the results obtained were surprising, and they convinced him that proper attention to this matter was a great aid to economy and efficiency. The experiments were carried out with an old-fashioned core stove, 36 ft. long, 10 ft. wide and 7 ft. high. Part of the heat was lost owing to thin walls and defects, etc. Ten tons of cores were loaded on to two carriages and were spaced out as much as possible to allow free circulation of air. The fire was lighted at 9 a.m. and was slowly built up until 4.30 p.m., when the carriages were pushed into the stove, and the doors were closed after opening the vapour outlet. The fire was then made up and the damper set. Next morning the cores were blacked, set on bricks and pushed into the oven again, and remained there until 2 p.m. They were then placed in position and cast; 8,000 cub. ft. of free air flowed through the oven every hour. The coke consumption was "seconds" foundry coke, 5 cwt., at 28s. per ton, 7s. The temperature in the core oven was steadily maintained at 275 deg. F. to 300 deg. F.

The drying of moulds in the foundry floor was an unpleasant part of foundry practice, owing to the fumes given off. Of course, it was usually arranged that this should be done at night, but, unfortunately, that was not always possible, and any system that would overcome the evil would be welcomed by all foundry workers. The Home Office would eventually compel them to find a better method than open fires. Now it was possible to have a drier which would give a large volume of air heated to about 150 deg. F. (65 deg. C.), and this would be ample to dry any "dry-sand" mould. It would prevent the local burning which was often seen with open fires.

Some pipes of 10 ft. dia. by 5 ft. long were being cast, and as they could not get the mould into the stove, it was dried in position. This was accomplished satisfactorily by means of a steel fire-pan perforated 38 6 in. deep, 2 ft. dia. It was stood on bricks in the centre of the mould and filled with furnace coke. The ring top plate was put in position and a small fire was then made on the top of the coke, over which they fixed a 6-in. pipe 2 ft. long, the end of the pipe being about 6 in. from the fire. A reducing pipe was attached to the compressed-air main with a ½-in. opening, and this was dropped 12 in. down the 6-in. pipe. Compressed air being turned on induced the free air to flow down the 6-in. pipe. The fire burned steadily and gave off sufficient heat to dry the mould in about 12 hrs. As the fire fell it was easily replenished by removing one of the sheet iron covers.

There were other methods with which he could not deal in the time at his disposal, but he hoped

his remarks would stimulate discussion and an exchange of ideas which would benefit anyone who was in doubt.

The Chairman (Mr. Masters) said many hot-air dryers were now in operation, and were very successful. He quite agreed with Mr. Meadowcroft that eventually the Home Office would take up this matter and insist on better ventilation and the elimination of smoke and fumes from the foundry.

Mr. Haigh said he thought it would be found impossible entirely to eliminate smoke and fumes from the foundry, but he looked for a more general application of hot-air drying. Some method of regulating the temperature was needed, and the economic temperature and the number of hours required for correct drying must be ascertained. The use of hot-air dryers was undoubtedly extending. At the Düsseldorf Exhibition there were several types of mould driers and core stoves, all using hot air.

Mr. S. G. Smith said they all knew that the higher the temperature in the stove rose, the more moisture was absorbed, and in most cases there was no escape for that moisture, which, therefore, had to be dried by the heat put into the stove. Consequently, a great number of units of heat were lost in turning that moisture into dry air. It might be said there was a means of escape at the bottom. In his opinion, that was not sufficient; there should be an escape for this heavily laden air before it was forced down to the bottom. If a satisfactory method could be devised for doing that, the drying would be easier and the cost would be reduced. He was not prepared to say how it could be done, but there was room for improvement in the design of even the latest types of stoves.

A vote of thanks was accorded to Mr. Sutcliffe and Mr. Meadowcroft, who briefly acknowledged it.

WALES AND MONMOUTH BRANCH.

The Wales and Monmouth Branch inaugurated their winter session on Saturday last by holding a smoking concert at the Grand Hotel, Cardiff.

In his opening remarks, the Branch-President, Mr. P. Leonard Gould, urged upon those present to use their best endeavours to make their Branch a real live one; to enlist new members and support the lecturers by their presence at the various lectures arranged.

The guest of the evening was Mr. John Cameron, the President of the Institution, who described some of the more prominent features he had noticed at the Düsseldorf Exhibition and in the Rhineland foundries. He also spoke in a hopeful strain regarding the position of trade, which he thought was about to improve. A most enjoyable musical programme was provided by Mr. Cuthbert Gould, and altogether a most helpful evening was spent. The Hon. Secretary (Mr. J. J. McClelland, Druslyn, Bishops Road, Whitchurch) would be pleased to hear from local gentlemen interested in the work of the Institution.

LANCASHIRE JUNIOR SECTION.

This section held its opening meeting on October 17. About ninety of the juniors attended. Mr. R. W. Stubbs, the President, was in the chair, and delivered his presidential address, taking as his theme "Some of the Aims and Ideals of the Institute." He said the Institute stood for research, knowledge, and wisdom, and sought to make apprentices into men of the highest skill by means of classes, lectures and social intercourse. The education of apprentices ought to proceed on carefully thought-out lines, with the definite object in view of reaching the top. It should give to the apprentice the power of vision to look ahead, insight into the underlying factors of the problems he was required to solve, the ability to think and to take the initiative, and an appreciation of the value of his skill to himself and to others. He must acquire knowledge of the materials he used and the processes of their production. All this was now within the reach of the foundry apprentice. In order to attain complete mastery of his trade, it was not necessary to take a degree in chemistry or metallurgy; a good knowledge of mathematics and chemistry combined with a good experience of shop practice constituted a practical and scientific education, and it could not be accepted as an excuse for failure that the apprentice was not offered opportunities or that his circumstances did not allow him time to study. In nearly all the large cities evening technical classes were provided, and the student was cordially welcomed, whatever his age. Neither was it a sufficient excuse that the additional work of evening classes could not be taken on because one already worked long enough in the foundry. Indeed, the study of the scientific side of the trade ought not to be considered labour. It was a pleasant recreation, opening up new field of thought, and the daily job became less monotonous when the mind was able to comprehend the reasons for the operations carried on.

In concluding, the President mentioned that the section now numbered 250 members, but he urged his audience not to be content with the progress already made. Those who had attended the meetings or joined in the visits to works during the last session had derived considerable benefit from the addition to their store of knowledge, and with their experience giving weight to what they said, they should use their influence to bring others into the section. By doing so they would establish the reputation of the Lancashire Junior Section for efficiency, knowledge and membership.

The "John Wilkinson" Medal Examination.

The prizes gained in the examination for the "John Wilkinson" Memorial Medal Examination, held on May 2, 1925, were presented to the winners by Mr. J. P. Bedson, of the firm of Messrs. Richard Johnson & Nephew. The donor of the medal is Mr. J. Thewlis Johnston, a director of the firm. Mr. J. S. G. Primrose mentioned that eighty candidates sat at the examination, and over eighty per cent. of them obtained more than half the marks. It was a very creditable performance. The excellence of the work made it a difficult task to determine the relative positions, and the six candidates who were highly commended each gained more than 85 per cent. of the possible marks. R. Yeoman gained the first place and became the Medallist; N. Masters and S. B. Poole, who tied for the second and third places, were awarded book prizes; Messrs. S. Batty, C. F. Brereton, A. Burgess, J. Patterson, E. Townsend, and W. Walsh were highly commended, and were given a souvenir of the occasion.

In making the presentation, Mr. Bedson remarked that the foundry industry ranked high in the scale of craftsmanship; it tested the capacity of the individual, and gave him the opportunity to impress his own personality on his work.

Mr. Bedson then delivered an address, in which he described salient points in the career of John Wilkinson.

Mr. J. G. Robinson, of Halifax, then gave his lantern lecture on "Moulding a Water-Jacketed Cylinder."

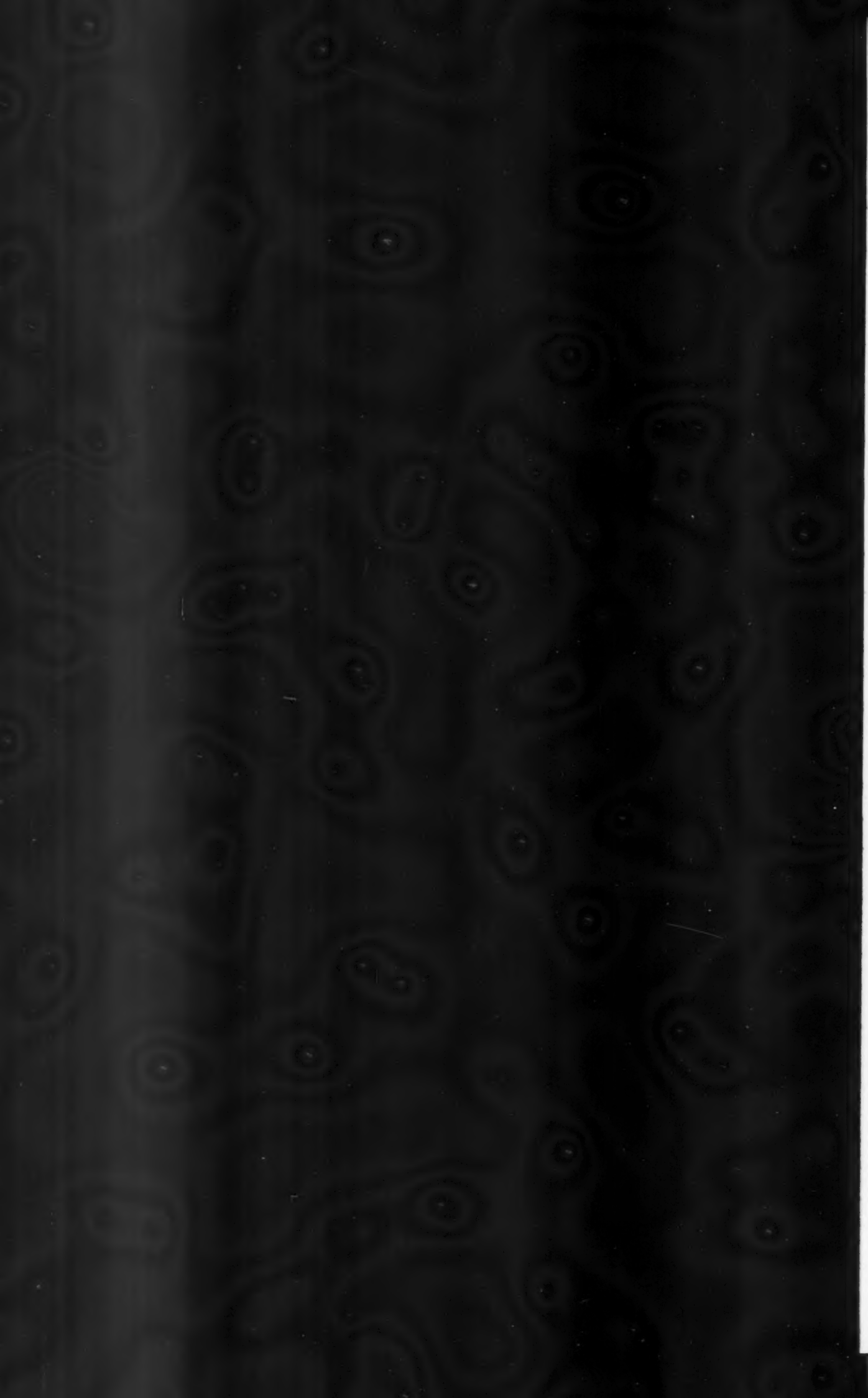
NEWCASTLE JUNIOR SECTION.

The first meeting of the session of the above Junior Section was held in the Y.M.C.A., Buildings, Newcastle-on-Tyne, on Saturday, October 17, Mr. J. E. O. Little (President) in the chair.

The lecturer was Mr. R. D. Burn, B.Sc., A.I.C., who took for his subject "The Combustion of Fuel."

The Paper gave rise to a long and interesting discussion, after which a hearty vote of thanks, proposed by the President and seconded by Mr. E. J. Rang, was accorded to the lecturer.

The Pneulec Machine Company, Limited, foundry engineers, of Mafeking Road, Smethwick, near Birmingham, are reorganising their selling arrangements, and in future representation all over the country will be made by representatives directly attached to the staff. In pursuance of this policy they have appointed Mr. S. E. Smith, Woodside, Rowlands Gill, Newcastle-on-Tyne, as representative for Northumberland, Cumberland and Durham, and Scotland.



Some Fundamental Relationships in Cast Iron, Wrought Iron and Steel Manufacture.

By J. E. Fletcher, Consultant B.C.I.R.A.

(*Continued from page* 324.)

Slag in Ferrous Processes.

In the three types of pneumatic furnaces used in the iron and steel industry the slags play an important part in controlling not only the composition of the metal by means of thermo-chemical reactions between the constituents of the metal and the slags, but by their physical condition as mobile fluids act as absorbers of certain undesirable migratory constituents such as sulphides and gases, and, by virtue of their heat conductivity or resistivity, may aid or resist heat flow from the fuel or heating gases to the metal in contact.

If the slag composition corresponds to a condition of chemical neutrality, the basic and acid oxygen contents being equal, when functioning at suitably controlled temperatures certain objectionable reactions at the metal surface may be stopped. Thus in the blast furnace, when the slag becomes neutral the further absorption of silicon from the silica in the slag ceases. Until this point of neutrality is reached the slag, if functioning at a sufficiently high temperature, will, if overcharged with silica, allow the reaction between the carbon in the metal and the free silica to proceed, silicon being transferred to the metal. When lime or magnesia are present in excess of the neutral condition the slag, if sufficiently fluid, will absorb sulphur from the metal. Further, such a condition prevents oxidation of iron and manganese, for, if lime or magnesia are present in excess of the neutral requirements, the oxides of iron or manganese cannot be absorbed by the slag. Similar actions take place in cupola practice, lime and magnesia in excess of neutral requirements acting as sulphur absorbents at definite temperatures. In this case, however, the slags are too acid (high in silica) to function efficiently and the iron and manganese oxidation proceeds in the direction of neutrality.

Moreover, the iron and manganese oxidation occurs at a level in the cupola higher than the position where the slags attain their proper working constituency and requisite fluidity and there is little or no contact of the fluid slag with the metal in the fusion zone. The coke below the fusion zone is then most in contact with the trickling slags and such desulphurisation as occurs takes place in the coke and not in the metal. Hence the developments of methods for sulphur removal from the metal by means of slag contact as it flows into or from the well of the cupola.

In the case of the acid Bessemer steel process it is worthy of note that the oxidation of the silicon, manganese and iron proceeds in the direction of the formation of a neutral slag but stops short at a composition which is similar to that of a normal cupola slag, in which the lime is displaced by iron and manganeous oxides. Here, as in the case of the cupola, the oxidation of the silicon, manganese and iron takes place in the absence of slag, the oxides formed uniting to form a slag at the metal surface. There is also considerable further oxidation of the iron and manganese which passes off as fume. From the estimation of the metal loss it would appear that a slag of neutral composition is actually formed, part of which is blown away as fume. When melting high manganese mixtures in the cupola there is often much loss in fume, and the slag tends toward the neutral condition, iron and manganese oxides being present in abnormally high proportions.

The basic Bessemer process furnishes an example of neutral or inert slags. During the process of the blow the basic oxygen content (in the lime, magnesia, alumina, and manganous and ferrous oxides) gradually increases from 40 per cent. of the total oxygen present in the slag to 50 per cent., at which point neutrality is reached. In the basic open-hearth steel process a similar transition in the working slags occurs during the melting and refining periods. The slags, immediately after melting of the charge, may consist of oxides containing 65 per cent. of acid oxygen. During the progress of the melt the constituency changes gradually from acid to basic, the basic oxygen content of the finishing slags being about 60 per cent. of the total oxygen present—the point of neutrality having been passed on the way. In the acid open-hearth steel melting process the working slags, by reason of the easy availability of the siliceous material in the hearth lining retain a strongly acid character. The acid oxygen content is high, from 70 to 76 per cent. of the total oxygen present in the slag. These slags are interesting from the fact that the composition is often closely similar to that of cupola slags. The pasty condition of slags containing more than 55 per cent. silica with 10 per cent. lime is analogous to cupola slags of similar composition which function badly and often give troubles in iron foundry practice, being useless from the desulphurising point of view and liable to affect the fluidity of the metal by encouraging "bridging" or scaffolding and by preventing clean and easy tapping through accretion on the walls of the cupola well.

Table IV.

Process	Nature of first slags	Inert or Neutral Constituents	Nature of finishing slags	Excess Constituents in slags
Blast Furnace	Acid	$2\,CaO.SiO_2$ $2\,MgO.SiO_2$ $2\,Al_2O_3 3SiO_2$	Basic	CaO & MgO
Cupola ..	Acid	$2\,CaO.SiO_2$ $2\,MgO.SiO_2$ $2\,Al_2O_3 3SiO_2$	Acid	SiO_2
Acid Bessemer ..	Acid	$2\,FeO.SiO_2$ $2\,MnO.SiO_2$ $3\,FeO.Fe_2O_3$	Acid	SiO_2
Basic Bessemer	Acid	$2\,FeO.SiO_2$ $2\,MnO.SiO_2$ $2\,CaO.SiO_2$ $2\,MgO.SiO_2$ $5\,CaO.P_2O_5$ $3\,CaO.Fe_2O_3$	Basic	CaO
Acid Open Hearth	Acid	$2\,FeO.SiO_2$ $2\,MnO.SiO_2$ $3\,FeO.Fe_2O_3$	Acid	SiO
Basic Open Hearth	Acid	$2\,FeO.SiO_2$ $2\,MnO.SiO_2$ $2\,CaO.SiO_2$ $5\,CaO.P_2O_5$ $3\,CaO.Fe_2O_3$ or $3\,FeO.Fe_2O_3$	Basic	CaO
Puddling Furnace	Acid	$2\,FeO.SiO_2$ $2\,MnO.SiO_2$ $5\,FeO.P_2O_5$ $3\,FeO.Fe_2O_3$	Basic	FeO
Electric Furnace	Basic	$2\,CaO.MgO.SiO_2$ $2\,MnO.FeO.SiO_2$	Basic	CaO

In the puddling process the slags are chiefly composed of ferrous manganous silicates and phosphates. At the commencement of the puddling the slags are feebly acid. As the "boiling" period is approached the basic oxygen content increases, and when the metal comes to grain the slag attains the neutral condition and finally contains excess basic oxygen as a result of the addition of iron oxide, produced during the oxidation of the iron whilst being balled.

Under correct temperature-control, the puddling process is regulated by the manipulation of the slag composition. The slags are never far removed from the neutral condition, and the process is slowed down on the one hand when the slag becomes acid and is hastened when the slag becomes basic. The neutral condition corresponds to a sus-

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pension of oxidation or refining during the first part of the process and to slackening in the rate of iron crystal growth, or coming to grain, in the latter half of the process.

It may be noted that in all ferrous processes mentioned the finishing of the smelting, melting or puddling charges must be carried out in the presence of fluid slags, which may be described as consisting of a neutral matrix in which is dissolved the active constituent necessary either for the alloying of the primary metal or for the removal of the last traces of an objectionable constituent. The temperature at which the slags are held is of course a vital matter, and the author attempted to emphasise this fact in a Paper read before the British Society of Chemical Industry in 1917 on the superheating of slags and metals during refin-

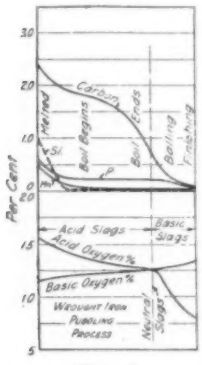


FIG. 2.

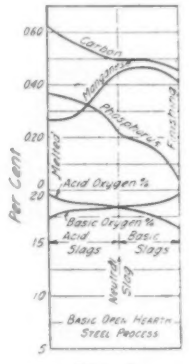


FIG. 3.

ing, smelting, and alloying operations. The necessity for a mobile fluid condition in working slags was first clearly demonstrated by H. H. Campbell in 1902 or earlier. Campbell's conclusions concerning the fluid condition and the influence of excess basic or acid constituents in the working slags of the steel processes were of fundamental importance, and must be considered as the real beginning of practical and scientific research.

In Table No. IV a summary of the above notes is given, and in Figs. 2, 3 and 4, graphs illustrative of the ruling types of slags in the transitions from the meta-stable to the stable neutral com-

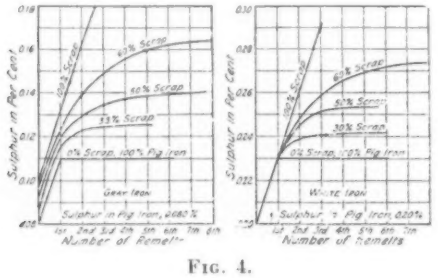


FIG. 4.

positions may help in emphasising the points raised. In Fig. 3 the progress of the transition from the acid to the neutral and finally basic condition of the working slags of the basic open-hearth steel process is shown.

No figures have been given relative to electric furnace slags, but their composition progresses from a feebly basic condition to a strongly basic one, the high temperatures available being sufficient to keep slags of high lime content in the fluid state. Such slags function well as absorbers of sulphur and phosphorus.

The Inter-Relationships Between the Structural Composition of Iron and Iron Alloys.

The well-known character of the polyhedral structure of wrought iron, dead mild steel, well annealed malleable cast iron and of silicious cast iron when slowly cooled from the molten state and completely graphitised points to the possession by the iron family at large of a common structural basis.

However masked this polyhedral micro-structure may be as a result of the thermal treatment and of the alloying, more or less permanently, with non-ferrous metals or metalloids it is generally possible so to heat-treat the cast or mechanically worked iron or alloy rich in iron as to bring to light the fundamental structure associated with maximum stability.

Underlying these problems connected with metal structure, it must be recognised that the outer form of an individual crystal is of secondary importance, the atomic structure as revealed by the exact detail of its space lattice and the disposition of the atoms being incomparably more important. This field of inquiry is being explored, but as yet the knowledge of the internal crystal structure (which is, in most of the technically important metals, of the same space lattice, as modified by the presence of one or more additional metals or metalloids) is far from complete. In cast iron the size of the crystal grain not only varies with the temperature of casting, the mass of which the grain forms a part, and the rate of cooling, but with the metals dissolved in the iron and with the constituents present at the borders of the crystal grains.

If it be accepted that in the molten condition cast iron consists of iron in which is dissolved the carbides, silicides, phosphides, and sulphides of iron and manganese, then on slow cooling to the stable condition where the whole of the carbon is in the form of graphite the polyhedral iron grains will be alloyed, more or less homogeneously, with the silicides of iron and manganese, and less homogeneously near the border surfaces with the phosphides and sulphides. In arriving at this stable condition the metal will have passed through the austenitic and pearlitic phases, graphite resulting from the decomposition of the carbides of iron and manganese, and finally the phosphide eutectic will have decomposed, yielding iron, graphite, and iron phosphide. The size of the final iron grains is conceivably controlled by the amount of supercooling which occurs just before solidification of the molten metal commences, the rate of crystal formation being dependent on the degree of supercooling and on the viscosity of the metal during crystallisation. This viscosity is not independent of the metal mass, and is influenced by the presence of foreign constituents dissolved in the iron. Hence it may be safely concluded that the size of the final stable crystal grains in a slowly cooled cast iron are influenced by the silicon, manganese, and phosphorus present in the molten metal. Any modification in the growth or shrinkage of the nascent crystal grains, as the metal is cooling through the critical change points associated with the passage from the gamma to the beta and alpha iron conditions, must be influenced by the presence of silicon, manganese, and phosphorus in the iron.

In cast iron the contents of silicon, manganese and phosphorus in the final stable grains will approximate to the values determined by the chemical analysis of the cooled metal. The influence of the heat liberated during the graphitisation of the primary iron carbide and of the gases liberated during solidification, some of which are entrapped within the solid metal, cannot be ignored. Both these liberations are accompanied by volume changes, and have an influence on the growth of the cooling crystal grains.

In the case of steel the lower carbon and silicon contents in ordinary straight carbon steels do not appreciably influence the grain size during slow cooling, but if the cooling is exceptionally slow and the metal mass great, graphitisation of the primary iron and manganese carbides occurs and the final stable structure is polyhedral-grained, the grain sizes being similar to those produced in cast iron of similar mass when cooled at the same rate. Here the graphitisation follows the grain boundaries as a result of the decomposition of the carbides whilst slowly cooling through the temperature range above 100 deg. C.

In the manufacture of puddled iron the iron grains are formed primarily during the supercooling of the alloy on the borderland between cast iron and steel (1.8 to 2.0 per cent. carbon). The grains grow rapidly, and have envelopes of very pure iron. The centres of the grains, or clusters of grains, are richer in carbon than the

outer envelope. The squeezed plastic mass of puddled iron is composed of crystal grains of similar form, and often of similar size to those associated with the structure of slowly cooled cast iron. The grain size in puddled iron is influenced by the manganese, silicon, and phosphorus content of the pig-iron from which the iron is made, and in some cases the original carbon content of the pig-iron appears to play a part.

Puddled iron may, therefore, be considered as being the result of slowly cooling a cast iron through the higher temperature ranges, the carbon, silicon, manganese, and phosphorus being removed by oxidation during the liquid and plastic ranges. The gradual reduction of carbon during the plastic period is equivalent to the graphitisation and decarburisation which take place during the malleable white-heart process. The two final and stable structures are remarkably similar both in the form and size of the polyhedral iron grains—in the wrought iron and in the completely decarburised areas of the malleablised cast iron. The coincidence of low manganese and silicon content in similarly grained wrought iron and malleable cast iron should be noted.

In the foregoing notes stress has been laid on the stable character of completely graphitised cast iron, steel and malleable cast iron, wrought iron being placed in the category of a slowly-cooled cast iron from which the carbon is removed by oxidation mainly during the semi-solidification of the virtually cooling metal, there being no pearlitic range during the transition.

This stable condition of approximately ferritic metal, calls attention, logically, to the fact that, when cast, pig-iron or steel-containing combined carbon is of unstable structure. The transition constituents austenite, troostite, martensite, sorbite, and pearlite in cast iron, malleable cast iron, and steel are relatively unstable in comparison with wrought iron and dead mild steel. To ensure the maximum stability of a steel containing a mixture of constituents a suitable heat treatment is necessary in order to homogeneously mix the constituents. In grey cast iron of normal composition the constituents are never homogeneously mixed as ordinarily cast, owing to the differential rate of cooling from the outside to the inside of the mass. Hence the attempts now being made to regularise the structure of cast iron by approaching a structure which is completely composed of pearlite and graphite.

A careful examination of a homogeneous pearlitic structure in cast iron shows that the pearlite occurs in polyhedral grains of similar contour and size to those which would result from slow cooling the cast iron, after reheating to the melting point, to the point of complete graphitisation. This pearlite filled grain structure is evidence of the effectiveness of the cooling rate which has produced it and of the stability of this type of pearlite. Experience has proved that confused structures in the pearlitic areas of steel or cast iron are indicative of internal strained conditions, the result of unequal rates of cooling within the mass. These heterogeneous structures may be connected with the imperfect diffusion of the various ingredients of the charge as melted in the cupola or open-hearth furnace.

Much remains to be done in the study of grain size in cast iron, wrought iron, malleable, cast iron, and steel, but there is much that suggests the possibility of the original grains, as formed during the solidification of the casting or ingot, retaining their form within the metal mass, masked though their boundaries may be by later reheating and the break-up of the internal structure of the grains. This suggestion receives support from the fact that an originally coarse-grained iron may be so heat treated as to break up the structure and destroy, apparently, the primary grain boundaries. Yet, after reheating to near the melting point and slow cooling the large grains reappear, being copies of their former selves. Perhaps they never actually lost their entity, but were masked by the thermal treatment, which only broke up the crystalline structure of their interiors.

(To be continued.)

FERGUSON SUPERHEATERS, LIMITED, have removed from Kingsway to 3 and 4, Clements Inn, London, W.C.2.

Semi-Steel.

BY J. H. LIST.

The writer does not apologise for using the title "Semi-Steel," though many seem to adopt the appellation apparently for want of a better name. The writer, however, uses this caption because it is a semi-steel inasmuch as it is not totally steel, yet contains steel. Recently many articles have appeared on so-called semi-steel, and these articles have dealt at some length with what happens chemically, and in some instances physically, all apparently from purely a theoretical point of view, and have overlooked the aspect of the usefulness of the casting produced.

As far as can be gathered, the makers of semi-steel all have different methods of mixing, and it is proposed to show yet a further method. In this method the writer has had several years' experience, and still produces serviceable castings. Some years ago the problem had to be faced of producing a certain class of casting as an alternative to cast steel, which was giving great trouble in producing sound castings after machining. The castings in question were of a receptacle character, and under working conditions contained a liquid of a very searching nature at a very high superficial pressure. The fact that the castings had to be machined all over on the inside intensified the difficulties, inasmuch as the moving of the skin of any casting exposes a more porous phase of the metal. The reason for such machining was to reduce friction of the liquid flowing through the receptacle. This then increased considerably the chances of obtaining a casting that would stand up to the test without giving the slightest sweat, punching or rusting up. There was a further stipulation, which was the metal must be suitably machinable. Naturally, however, it was harder than grey iron. The cupola used was a 4-ton per hour size, having a tuyere area of one-fifth the area of the melting zone, the air pressure being 14 oz. The final mixture went through four meltings: (1) A mixture consisting of 67 per cent. scrap and 33 per cent. hematite, which was run into pigs; (2) these pigs were charged together with 7 per cent. mild steel, the melt being run into pigs; (3) the pigs from (2) were charged together with 10 per cent. mild steel, which in turn were run into pigs; (4) the pigs from (3) were charged, and the resultant iron was poured into the moulds.

The above melts were made at separate blows, actually on different days. During all above melts 9 lbs. of limestone were added to every 4 cwt. charge of iron.

The mild steel used was old boiler plates $\frac{3}{16}$ in. to $\frac{1}{4}$ in. thick, whilst the hematite was a No. 3 East Coast and the scrap "best engine." The scrap and heads from the castings were not used again in the semi-steel mixture, but thrown amongst the cast-iron scrap heap, from which the municipal castings were made. This kept as far as possible the semi-steel castings constant. A good quantity of pigs of semi-steel mixture was put through at the same time, sufficient to meet demands for several weeks. These special melts were always made at the end of the day's blow. The final melt, that is No. 4, had a day set apart for semi-steel castings alone.

There is no receiver to the cupola, but the iron was run into a 30-cwt. ladle, and the moulds were poured from this ladle to enable moulds to be cast hot. Large heads and risers were run up, to act as self-feeders, and the castings were made on end. The cupola lining suffered severely, and it was difficult to get a ganister that would hold up to the scorching effects. This method was rather a costly undertaking, but, on the other hand, the castings demanded a good price.

Test bars were taken regularly, giving the following average results:—Tensile, 17 tons per sq. in.; transverse (at 36-in. centres with a 2-in. × 1-in. bar), 37.5 cwts.

The analyses show very low phosphorus and manganese contents. The silicon is round about 1.5 per cent. By adding approximately 6 per cent. of mild steel to each charge of cast iron the fusing effect on the mould face is considerably reduced, the result being the castings have a much better skin. The skin, however, is of a whitish grey nature and not the blue, as is obtained when using all pig-iron.

XUM

Regulating Valves—II.

By Ben Shaw and James Edgar.

While some spherical valve bodies used for regulating steam to cylinders are of cast iron, the larger ones are invariably steel castings, and although the principles involved in the preparation of their moulds are similar to those for cast iron, modifications must be made to suit the special peculiarities of steel and the moulding practice prevailing in steel foundries. Reference has already been made to the fact that the metal of which the castings have to be made has a distinct bearing upon the type of pattern work supplied. This is true in those shops that frequently

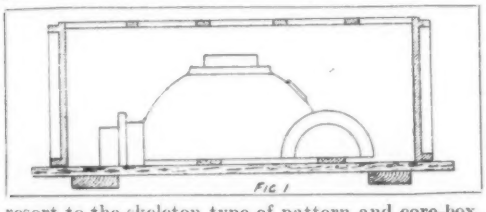


FIG 1

resort to the skeleton type of pattern and core-box. Generally speaking, it is customary to supply patterns having a solid exterior for the steel foundry. It is usually asserted that the steel moulder prefers such a pattern, but this might well apply to both iron and brass moulders. In steel founding, however, the sand is rammed much harder, and a solid pattern is preferable for this reason, but, in addition, the sand is coarse in texture and contains less bond than that for iron or brass, and it is, consequently, not so readily made up. This fact, too, makes a solid pattern desirable. The conditions of trade may cause the steel moulder to use an unsuitable pattern for a job of this kind, but, in busy times, a solid pattern is invariably required.

Practically all patterns that are sent to a steel foundry have certain additions made to them at the foundry. These consist mainly of brackets, or webs as they are more frequently called, but many foundries take the precaution of adding to

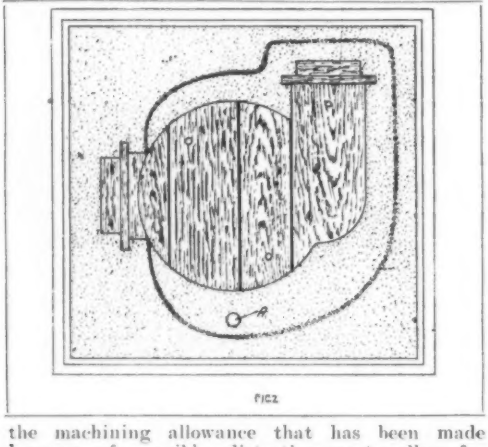


FIG2

the machining allowance that has been made because of possible distortion or to allow for annealing skin or the upper parts where dross is likely to collect. The webs are attached between the flanges and the body, and are used to support the metal and reduce the possibility of fracture or distortion due to shrinkage. Steel contracts quickly on the point of solidification, and, since it is very weak at this time, a fracture is likely to occur at the junction of sections, particularly if sharp angles are formed between them. The small webs are made considerably thinner than the sectional thickness of the casting, so that they will solidify first, in which condition they give support to the casting and assist it in overcoming the resistance of the mould. These webs are invariably removed from the finished casting before it is delivered, unless they are inaccessible or their presence on the casting is unimportant.

Making the Drag.

The drag part of the mould for a spherical valve body of this kind, that is to be cast in steel, is usually made by the turnover method for the obvious reason that the ramming of the sand by this method is more regular and also because the contraction webs which are only loosely attached to the pattern are not so likely to be displaced; the removal of the wires locating them is more easily effected during the process of ramming them when bedding in is resorted to, for which the sand must be tucked under the pattern. The fact that the joint of one of the branches projects from the main pattern joint of the bottom part does not materially affect the procedure. A ramming board may be used as in Fig. 1, or a sand bed may be prepared. With the former a couple of pieces of wood or other packing having a thick-

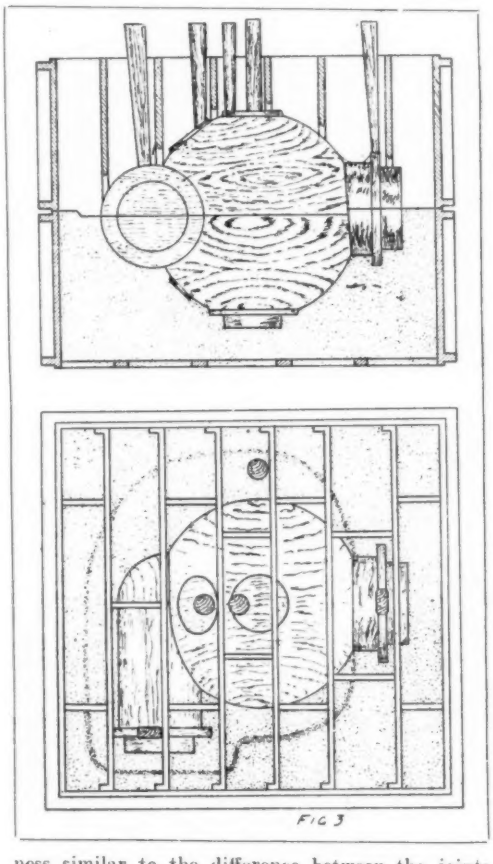


FIG 3

ness similar to the difference between the joints should be used to support the main pattern section. When a sand bed is used for ramming the drag, a recess can be made to receive the branch, the sand being cut away from the sides so that a raised joint will be made on the mould when it is turned over.

The box part surrounding the pattern section should be reasonably deep to give at least 4 in. of sand over the bottom of the pattern, and, if of suitable size, flat bottom bars will suffice. Box bars may, of course, be used, but a consideration must be given to the contraction of the resulting casting when placing them, otherwise the casting may be unable to overcome the resistance of the mould due to the support of the bars. The composition of sand used for moulds to receive steel is of considerable importance.

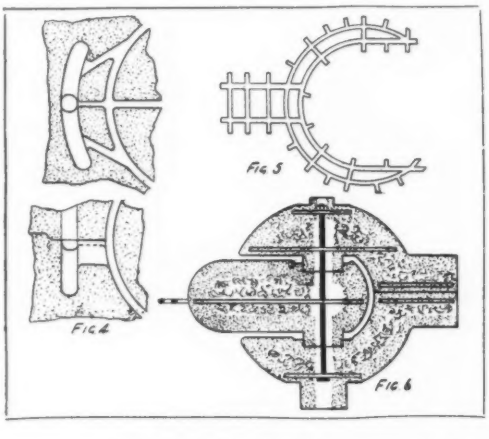
Choice of Sand.

The high temperature of the fluid metal necessitates a sand that contains a very low percentage of fusible impurities, otherwise the casting will

be more or less scabbed according to the amount of these impurities forming the face of the mould. A good rock sand, together with Trent sand and additional bond in the form of China clay, when necessary, makes a good facing mixture for a mould that is to be dried. In some steel foundries steel moulders' "compo." enters largely into dry sand mixtures; it is not essential, however. Economical considerations have a bearing upon the choice of sands for suitable mixtures. The sand should be well rammed, particularly against the face of the pattern, and chills should be used where there is considerable change in the metal thickness.

Chills.

The use of chills is frequently necessary against flanges, because of the additional thickness of metal in them over the body thickness. They are used to equalise the rate of cooling of the various parts of a casting which reduces contraction strains, and consequently gives a sounder casting. When these have been located, a process that is carried on as the ramming of the sand proceeds and the box part is finally filled and surplus strickled off, the drag is ready for turning over. If the box part is provided with journals it is only necessary to suspend it on these in slings or on beams and manipulated by a crane; turning over is then comparatively simple. Without journals the box part must be lifted on its side and rolled



over, a method which is likely to cause a certain amount of jolting, with possibly detrimental effects on the mould. The use of journals is preferable, particularly for medium-sized work.

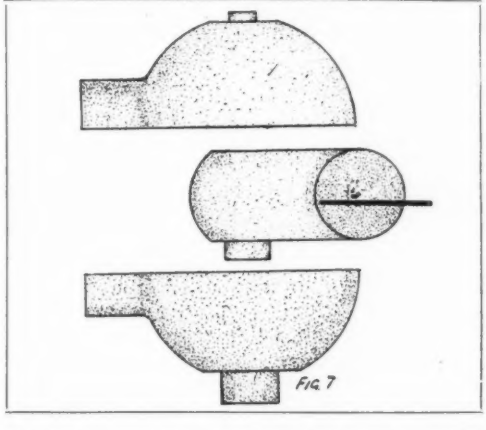
With a valve body of this kind, it is advisable to secure the pattern to the bottom of the drag before lifting to avoid a premature stripping; a couple of screw-eyes passed through the sand into the pattern carrying a bar, subsequently wedged from the box will suffice. When the box part is turned over and located on the foundry floor the mould joint can be formed, ready to receive the other pattern section. The formation of the cope is almost a repetition of the drag, but arrangements must be made for running the job, and risers need to be provided. Then while the use of the box bars is not necessary in the drag, some support should be given to the sand in the cope other than the box sides. Short bars should, therefore, be secured to the sides, shaped bars for preference, but they should not be too near the pattern.

Runners and Risers.

The gating of such a job as this is best done from the joint, the gates being cut so that they are easy of access for manipulating against wash. Some steel moulders use a vertical spray on the line of the ribs, but there is more likelihood of dirt entering the mould with the metal when this method is adopted. A down gate about 2 in. diameter, placed as at A in Fig. 2, would suffice, the runner being cut from the drag after the cope has been rammed and lifted. Steel castings need to be well supplied with risers. For this purpose riser sticks should be located on the top edges of the flanges on the top facing, and a riser from the manœuvring valve facing would also be advantageous, particularly if additional machining allowance has not been made. A sectional elevation, as well as a plan, is shown in Fig. 3, and the suggested form of box bars and the positions of runners and risers are here shown.

Finishing Details.

When the cope has been rammed up, the runner and riser sticks withdrawn and the pattern section secured preparatory to lifting, it can be turned over for the withdrawal of the pattern. It is frequently convenient to cut away the runners from the drag before extracting the pattern, but this is a matter of opinion. The joint can be swabbed and the pattern sections well rapped before stripping, and, with a reasonable form of pattern, there should be no difficulty in securing a clean withdrawal. Some amount of sleeking is nearly always necessary, and only corners that are essential should be left. All corners should be rounded, not so much to strengthen the resulting casting, but because they are subject to erosion by the hot metal and the sand so dislodged is very likely to cause a waster casting. The whole surface of the mould should be swabbed and sleeked; in this connection it may be advantageous to state that a brush is a poor substitute for a sleeker. In some steel foundries a facing wash is applied directly the mould has been completed. The method has economic advantages, since it involves only one drying. All corners of sand in the mould should be well nailed, whether they are round or square. They are used primarily to support the sand and reduce the pos-



sibility of erosion, but they also serve a useful purpose in chilling fillets when special chills are not essential. Another precaution which is more generally taken by the steel moulder than either iron or brass moulders is the depression of the joint. This prevents crushing at the joint when the parts are finally assembled, and in a measure the fin formed on the casting tends to clean the surface of the metal as it rises in the mould. A suitable form of runner is shown in Fig. 4. It will be noted that the main gate enters at the junction of the web with the body and subsidiary runners are formed on the joint slightly tangential to the circular thickness.

Core-Making.

The making of the cores involves, if anything, greater care than the mould. The same precautions must be taken as have been mentioned in preparing the mould and those surfaces against which the metal washes on entering the mould require to be specially nailed. Contraction webbing is equally necessary on the inside of the job, and this involves the cores. Unless a full corebox is supplied loam, or, to be precise, compo. in its more plastic form, is generally used. It need not necessarily be the recognised compo.; a good steel moulding sand, such as has been referred to for the mould, will suffice. Compo. in itself is not so frequently used for this work, but it is used in conjunction with a rock sand of good quality. The mixture used should be more open in texture than is used for the mould, and coke may be milled with it for this purpose. All the cores necessitate the use of grids with suitable staples cast in them for lifting purposes. A suitable type

of grid for the main bottom core is shown in Fig. 5. This shows the joint grid, another grid being necessary to carry the sand under the block. The two grids should, of course, be fastened together.

The ribs in both top and bottom of the main box need to be cut so that they can be withdrawn. The better way is to dowel the parts, but sometimes these ribs are left to be cut at the foundry to the moulder's requirements. They are then rarely dowelled, being simply secured loosely with nails that can be readily extracted when filling the corebox. A ventilating chamber should be prepared in each part of the main core, the facilities for the escape of air and gases being made through the outlet branch. Some moulders arrange for a connection of the vents on the centre joint of such a core as this: it is better, however, to connect the vent through the centre as indicated in Fig. 6. The separated cores for the job are shown in Fig. 7, and it will be noticed that the grid in the inlet branch core projects in order to give balance when setting in the mould. Even with this support it is advisable to make provision for bolting the cores together when finally set. This, of course, is best done through

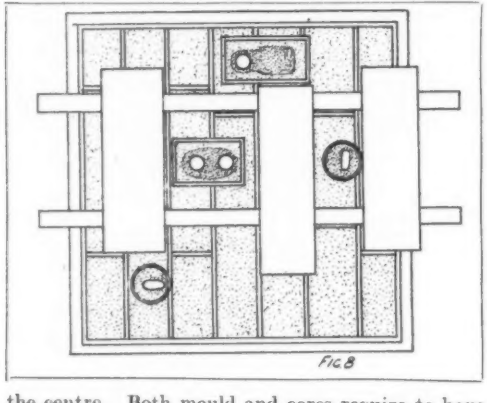


FIG 8

the centre. Both mould and cores require to have a facing wash before they are finally dried. A thin solution of compo. with a little China clay may be used or plumbago and China clay makes a good facing. When the parts are thoroughly dried arrangements can be made for assembling them and for the runner and riser basins to be used for casting. In assembling, the thickness should be carefully checked, particularly when the cope is tried in position, because of the tendency to creep at the joint. It is advisable to make use of clay to check thicknesses when they cannot otherwise be tested. A section of the assembled mould ready for casting is illustrated in Fig. 8.

It may be noted here that some foundries prefer to cast a head on the top facing, but if additional machining is allowed a riser such as is shown will invariably suffice. There are, of course, variations of these spherical regulating valve bodies, but the underlying principles in the construction of their moulds, when steel castings are required, are similar to those here described. All steel castings of this nature should be annealed. Sometimes they are stripped from their moulds while still hot and transferred to a previously heated annealing oven, but many prefer to allow the casting to cool to a normal temperature before removing them from their moulds, although the casting is invariably eased to allow it to contract with as little resistance from the mould as possible. The temperature of the annealing oven should be raised slowly to about 800 deg. C., and it is very important to reduce the temperature again to normal very slowly. The process is primarily necessary to release strains due to unequal contraction, but advantage is taken of the fact that a distorted steel casting can be practically restored to its true shape when skilfully packed.

DR. R. A. JOYNER has died as the result of an accident which occurred in the research department of Nobel's Explosives Company Limited, at Ardeer.

I.B.F Notes.

At a general council meeting held at the Station Hotel, York, on October 10, the following were elected:—

As Subscribing Firm.

Darlington Railway Plant & Foundry Company, Limited, *Newcastle.*

As Members.

A. Bennett (Master Patternmaker, Hyde), *Lancashire.*

E. A. Chell, M.I.Mech.E. (Managing Director, Rodney Foundry Company, Limited), *London.*

W. J. S. Gillespie (Ironfounder, Bonnybridge), *Scotland.*

J. Heatley (Foundry Owner, Spring Bank Foundry, Blackburn), *Lancashire.*

D. W. Maddock (Ironfounder, Oakengates), *Birmingham.*

A. H. Moore (Foundry Owner, Standard Brass Foundry, Benoni, South Africa), *London.*

G. Swaine (Foundry Foreman, Marshall, Sons & Company, Limited, Argarpara Works, Karmarhatti P.O. 24, Parganas, India).

W. J. Tarrant (Director, Dorset Iron Foundry, Poole, Dorset), *Birmingham.*

E. J. Whitehouse (Foundry Owner, Phœnix Foundry, Tipton), *Birmingham.*

A. V. Spafford (Director, A. Spafford & Company, Limited, Imperial Works, Brown Street, Sheffield), *Sheffield.*

C. E. Spafford (Director, A. Spafford & Company, Limited, Imperial Works, Brown Street, Sheffield), *Sheffield.*

C. Nelson (Furnace Engineer), *Sheffield.*

G. B. Greensall (Works Manager, Triplex Foundry, Great Bridge), *Birmingham.*

E. J. Yates, B.Sc. (Metallurgist, Goldendale Iron Company, Stoke-on-Trent), *Birmingham.*

As Associate Members.

A. Anson (Foundry Foreman, Bury), *Lancashire.*

L. R. Armstrong (Engineer and Metallurgist, 17, Victoria Street, S.W.1), *London.*

B. Heaton (Foundry Foreman, Keighley), *West Riding of Yorkshire.*

P. Parrington (Foreman Patternmaker, Bury), *Lancashire.*

H. G. Wright (Foreman Patternmaker, Stockport), *Lancashire.*

H. B. Platt (Metallurgist, Baker, Perkins, Limited, Peterborough), *London.*

J. W. Clarke (Foundry Foreman, Baker, Perkins, Limited, Peterborough), *London.*

J. S. Massey (Works Foreman, Triplex Foundry, Great Bridge), *Birmingham.*

R. D. Burn, B.Sc. (Analyst in Works Laboratory, Wallsend), *Newcastle.*

A. Elder (Foundry Manager, Derby), *East Midlands.*

H. Heatley (Draughtsman, Blackburn), *Lancashire.*

J. Halloran (Foreman Moulder, Derby), *East Midlands.*

J. Kershaw (Foundry Foreman, Radcliffe), *Lancashire.*

J. C. Mahindra (Engineer-in-Charge, of Howrah Engineering Company, Limited).

W. Morris (Superintendent of Iron Foundry, Dick Kerr Works, Preston), *Lancashire.*

H. A. Greaves (Engineer and Metallurgist, Lancaster Street, Sheffield), *Sheffield.*

W. Levesley (Director of Metallurgical Works, Sheffield), *Sheffield.*

W. S. Richards (Castings Inspector, Devonport), *London.*

J. Robinson (Consulting Engineer, Calcutta, India), *Birmingham.*

A. M. Wilson (Foundry Superintendent, Burnham-on-Crouch), *London.*

As Associates.

W. Dubberley (Coremaker, Smethwick), *Birmingham.*

G. L. Nesbit, (Foundry Student, Swinton, Yorkshire), *Sheffield.*

The places printed in italics are the branches to which the entrants have been assigned.

Dust-Proof Foundry Cranes.

When dealing with transport at Düsseldorf Exhibition we pointed out that we received the impression that German foundry owners meant to make serious endeavours to ensure that their foundries were thoroughly modern in this respect. A similar movement, though unorganised, is noticeable in this country, and it is in support of this movement that we devote from time to time space to the developments which engineers devise for improvement of transport in foundries. We therefore welcome the opportunity of bringing to the notice of the foundry industry the latest "dust-proof" overhead electric travelling crane introduced by the firm of S. H. Heywood & Company, Limited, of Reddish, near Stockport.

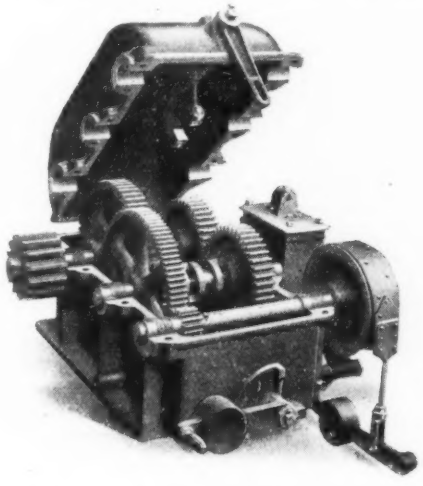


Fig. 1.—Hoisting Gear Case of "Dust-Proof" Cranes.

This crane has been specially designed for use in foundries and other places where dust and dirt are inevitable, with the object of reducing to a minimum the breakdowns and stoppages which are to be associated with unprotected open-type overhead travellers used under such conditions.

Surely there is no place where unforeseen and enforced stoppages of the overhead crane may lead to more unfortunate results than in a foundry through a ladle of molten metal being suspended helplessly and immovably in the mid air. The whole tendency of modern engineering is completely to enclose running machinery with the double object of ensuring full and continuous lubrication of the working parts and of excluding dust and destructive grit.

If the enclosure of running gears is anywhere worth while it must surely be of paramount importance in the case of an overhead traveller, where the running parts are up aloft, out of the way, and where supervision is not easy and maintenance inconvenient and costly. Dirt and dust, carried upwards by the currents of warm air, settle upon the roof and upon the roof principals, and by the vibration are shaken down upon the crane as it travels about the shop.

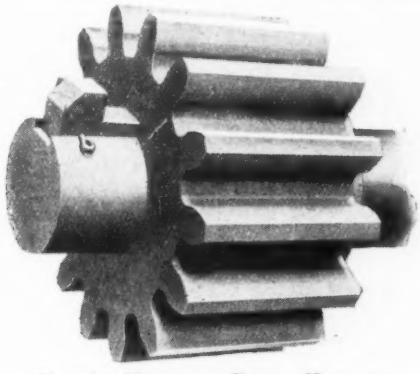


Fig. 4.—Method of Fixing Keys on "Dust-Proof" Cranes.

The foundry manager should be in a position to know that any machinery under his charge is readily accessible for repair and maintenance, and is inclined to be distrustful of any enclosure that may decrease that accessibility on which he has always relied.

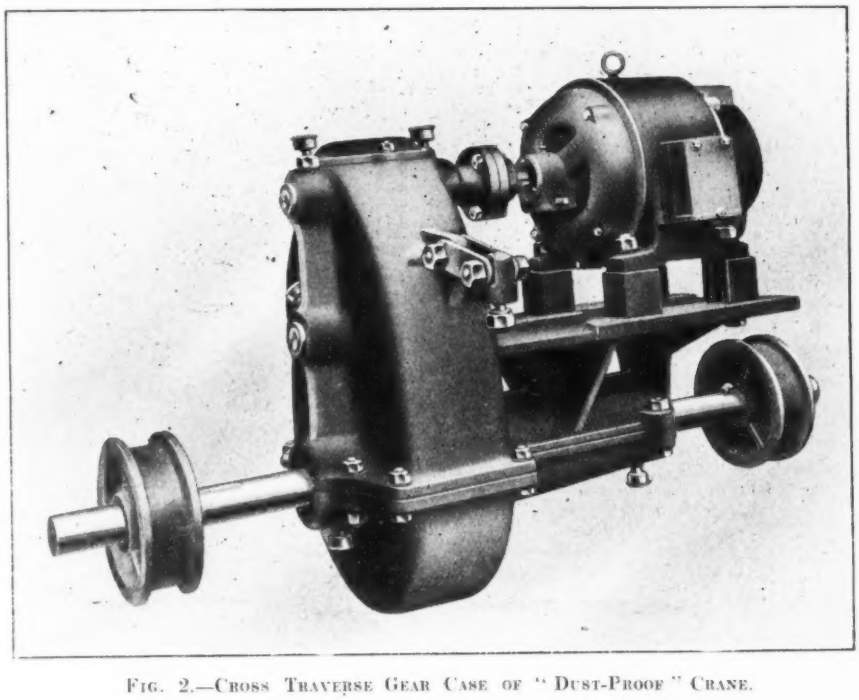


Fig. 2.—Cross Traverse Gear Case of "Dust-Proof" Crane.

There is a tendency in these days to decry conservatism in engineering, but it must be remembered that conservatism of the sort under consideration is founded upon long practical experience, and the successful modern designer must always take into consideration the underlying

truths upon which such conservatism has been built. The first task that confronted the firm of Messrs. Heywood was, therefore, to convince crane users that the parts enclosed needed no attention whatsoever during the period of their working life and that they give a definitely adequate degree of accessibility. Once the disadvantages of enclosure were overcome, the advantages were so obvious that practical engineers were only too willing to pay the small extra price that enclosure involved.

Fig. 1 shows the hoisting gear case of a standard 10-ton crane. The gear case is split horizontally through the bearings, and the removal of the upper portion permits every shaft and wheel to be lifted straight out of the case. There is, in addition, a light hand cover extending over almost the whole upper surface of the gear box; when this alone is removed there is complete access to the whole of the enclosed machinery. The gunmetal bearings are solid, in order to prevent the escape of oil from the gear case, and because a worn bush can be withdrawn and replaced in a few minutes without disturbing the gear case, since each bush is held in place by a single external set screw; and thirdly, because the new bush restores automatically the original alignment and centres of the gears.

The type of crane under review utilises grease lubricators for the bearings, because not only does the grease form an oil seal against the escape of oil from the gear case, but the squeezing of the grease outwards along the shaft neutralises any tendency for the dust to get in between the shaft and its bearing.

In Fig. 2 is illustrated the cross traverse gear case which completely encloses the gear operating the cross traverse motion on the crab. The design of the cross traverse gear case involves a point of serious importance. On no consideration must the wear of the crab axle bearings affect the mating of the gears. Where this gear case is rigidly attached to the crab frame any wear on the crab axles will

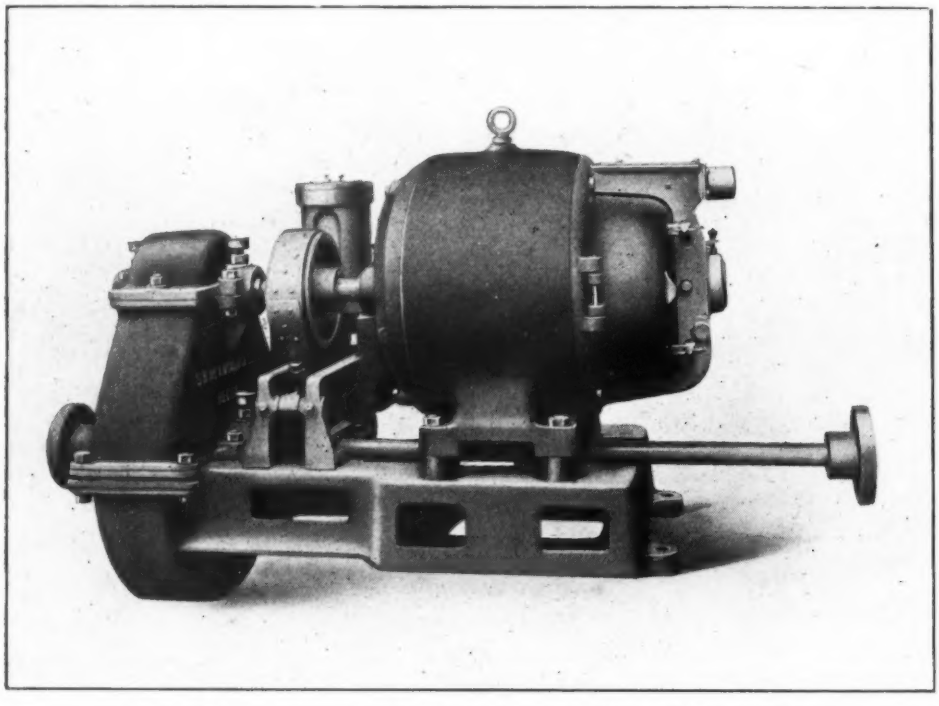


FIG. 3.—LONGITUDINAL TRAVEL GEAR CASE FOR A "DUST-PROOF" CRANE.

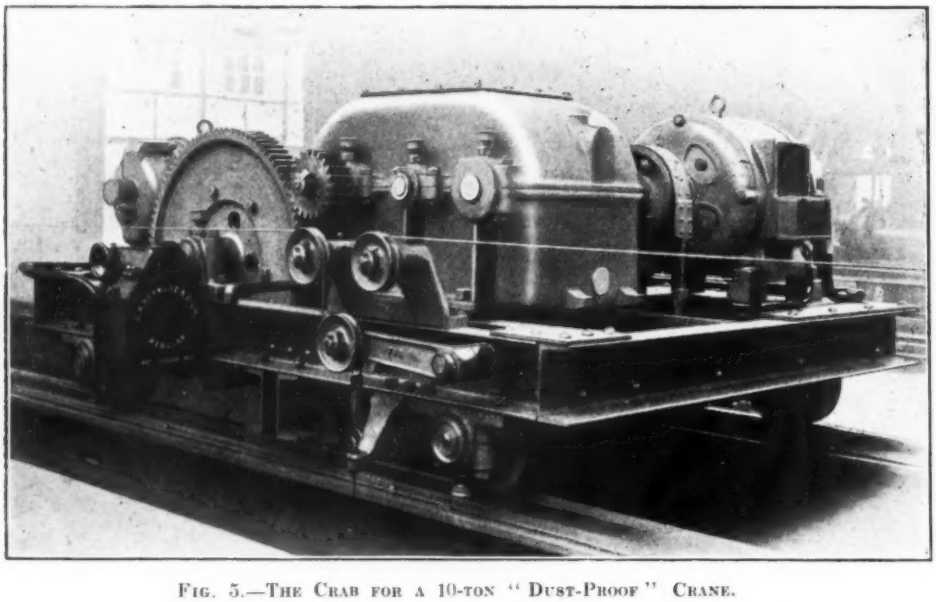


FIG. 5.—THE CRAB FOR A 10-TON "DUST-PROOF" CRANE.

force the teeth of the gear wheel on the axle into deeper mesh with its mating pinion, and quite a small amount of wear will throw a considerable portion of the weight of the loaded crab on to these teeth. There have been several cases of engineers having condemned enclosed gear cranes for this very reason. In the case of the Heywood "dust-proof" crane the difficulty has been met and satisfactorily overcome in a unique manner. The entire gear case, including the motor, is mounted upon the axle itself, and the only connection between the gear case and the crab frame is the short link shown in Fig. 2.

Accessibility is assured, for by removing six nuts the bottom portion of the case can be taken away and the whole can be lifted clear of the crab. The motor pinion is exposed by removing a small hand cover, and by loosening a single set-screw the intermediate gears are released.

Fig. 3 shows the longitudinal-travel gear case, and here again the whole of the gearing, including the motor, has been mounted upon one base, and in itself forms a rigid self-contained unit. As before, the gear case is split across the centre line of the bearings in the interests of accessibility. The upper cover is easily removab'e by hand. A brake drum is keyed on to an extension of the motor shaft, and in the particular gear case illustrated (Fig. 3) an automatic solenoid brake is fitted which promptly brings the crane to rest when the controller is brought to the "off" position. Where the automatic brake is not required a brake is fitted which is operated by means of a foot lever in the driver's cage. The suitability of this position is unquestionable, as much of the undue wear of crane gear teeth has been due to the interposition of gears between the brake and the heavy and rapidly revolving motor armature.

This arrangement has the further advantage of applying the retarding effort at the centre of the longitudinal shaft instead of at the end. Should the brake be fixed at one end of the shaft its sudden application will twist the whole crane on the gantry. The makers claim that no deflection in the structural portions of the crane under load can affect the working of the gears or nip the shafts in their bearings.

Fig. 4 shows a very interesting way in which Messrs. Heywoods have made it impossible for any key to become loose. The keys in overhead travellers are heavily stressed by the sudden and constant reversals of the train of gears, and the fact that they are constantly churned round in oil aggravates the difficulty of keeping the keys in position.

The methods which this firm have introduced and adopted effectually prevent the key from slacking back under any conditions whatsoever. After flogging home the key, a split pin is passed through the shaft and the key, as is clearly shown in the illustration.

Fig. 5 is a clear illustration of the Heywood "dust-proof" 10-ton crab, and a very good idea of the massive proportions of the gear box can be gained from this picture, whilst Fig. 6 illustrates two "dust-proof" cranes working in a North-East Coast steel foundry.

Company Reports.

Babcock & Wilcox, Limited.—Interim dividend, 5 per cent., free of tax.

Wallace Bros., Limited.—Dividend, 6 per cent. per annum; depreciation, £2,000.

Fisher & Ludlow, Limited.—Dividend, 7 per cent., free of tax, on preference shares on account of arrears.

Fig. 6.—"Dust-Proof Cranes installed in a N.E. Coast Steel Foundry.

Gandy Belt Manufacturing Company, Limited.—Interim dividend, 7½ per cent., actual, on ordinary shares.

Yates & Thom, Limited.—Dividend, 7½ per cent., less tax, on ordinary shares for year; carried forward, £15,554.

Chesterfield Tube Company, Limited.—Interim dividend, 3¾ per cent. on 7½ per cent. cumulative preference shares.

Furness, Withy & Company, Limited.—Dividend for half-year ended October 31, 2½ per cent. on ordinary shares, free of tax.

Cammell, Laird & Company, Limited.—Usual interim dividend, 2½ per cent., actual, less tax, on 5 per cent. cumulative preference shares.

Sheffield Steel Products (Stores), Limited.—Balance of loss on profit and loss account, £13,324; trading loss debited to this account, £4,111.

George Turton Platts & Company, Limited.—Profit, £22,547; brought in, £3,318; dividend, 7½ per cent., less tax, on ordinary; reserve, £5,000; carry forward, £10,977.

Glenboig Union Fire-Clay Company, Limited.—Net profit, including £4,868 brought forward, £31,084; dividend, 20 per cent., less tax, £23,562; carry forward, £7,521.

Plumb-Bob and Level.

By J. McL.

It is surprising in how few pattern-shops and foundries the plumb and level are used. These two tools are not complementary to each other and yet one seldom thinks of the one without the other presenting itself. This, no doubt, is because they are used to obtain the same end, *i.e.*, the setting up of work with horizontal faces exactly level and vertical faces at 90 degs. to them. In pattern-shops and foundries, where only small and medium sized work is made, the ordinary try and set squares obviate the use of plumb-bob and level, but when large work is made try and set squares are not as accurate. We have seen an oak try square used with a blade about 5 ins. wide and 6 ft. long, the stock being about 3 ft. 6 ins. long: the most careful craftsmen cannot use a tool of th's kind to get accurate results. If the blade warps only slightly a considerable error will result. How often we have seen a pattern-maker twisting a large square about until it showed his job correct! It is not good practice to use a try square with a blade more than 2 ft. 6 in. long. The maximum size for a set square should be 1 ft. 6 in. or 2 ft.

There are many men who think that the plumb-bob and level are slow methods of testing work, but this is a fallacy. When a large pattern, such as an L.P. reciprocating cylinder or a turbine casing, is being made, error is impossible if each frame, vertical and horizontal, is tested for plumb as it is put in place. In constructing large barrels, that is, seven or eight feet long and six feet or more in diameter, either of two methods can be adopted; cross frames may be made at the bench and afterwards set between built rings on grounds, or a framework may be constructed of stays fastened between grounds. In some shops the barrel is lagged up complete and then tested for square: if very great care has been taken in making the various grounds and frames the cylinder may be fairly accurate but, in nine cases out of ten, a considerable amount of planing will be necessary. It is surely much better, therefore, to test in stages.

A cylinder is a good job for demonstrating the use of a plumb-bob, and also a level. The best practice is to build the cylinder on a level floor, temporarily screwing the bottom ground to the floor in such a manner that the screws can be easily withdrawn when the job is complete. The framework and grounds can then be built up, the plumb-bob and level being used at every step. When the barrel is finished the column feet and the several branches can be fitted in their respective positions and, if a plan of the cylinder, with centre lines, flange faces, etc., has been drawn on the floor, no mistake can be made in fitting. Especially are plumb-bob and level useful when several men are employed on a large job because the man in charge sets out the drawing on the floor and the necessity for men, when fitting on various parts, referring to a drawing is obviated altogether. Centre heights are obtained with a measuring rod and distances from the centre line of the cylinder are set out on the floor. Only small indicator bosses, and ribs that are not very particular, are measured into position.

In the foundry, the plumb-bob and level are used when setting up work. It is, of course, quite common practice to sweep up a sand barrel and fit pattern parts to it. Use cannot be made of a level floor but the branches, feet, etc., will already have been erected in the pattern-shop and, when centre lines have been marked off on the sand barrel with the aid of trammels, the plumb-bob and level laid on straight faces will enable the various parts to be set accurately. When what may be termed main faces are at an angle to the horizontal, a special jig piece can easily be made of, perhaps, 1-in. timber one edge of which will be level when the main face angle is correct. For loam work, the plumb-bob and level are invaluable. It often happens, when working in loam, that part of the pattern work has to be removed temporarily; it will probably go back into position accurately when required, but careful checking is always valuable.

Pattern-makers and moulders who have always used plumb-bob and level may be surprised to learn that there are many shops which do not encourage their use; the writer served his apprenticeship in a shop doing fairly large work, but he scarcely knew of the existence of such tools until after he became a journeyman.

We have seen home-made levels, but making them is a tedious business and scarcely worth while. Very short levels are occasionally used, but they cannot be recommended. A more useful level is one nine to twelve feet long. In shops where there is much large work it is advisable for the firm to provide a level which may be two feet long. It can be readily understood that the longer a level is, the greater is its accuracy. A tool of great usefulness is the combined level and plumb. Spirit levels are not always "level," and an inaccurate level is an exceedingly bad tool.

With regard to plumb-bobs we have seen many different kinds used. In an emergency, a nut tied to a piece of twine will serve equally as well as a highly finished brass plumb-bob with a steel centre; when a straight edge is used, with a centre line gauged from the edge, nothing more elaborate than this is necessary as the nut will swing as freely as a good plumb-bob. The statement was made in a contemporary, recently, that as a makeshift plumb-bob, a heavy bolt with the line tied round the waist of it was unsatisfactory, because the bolt would not hang plumb. The point is, however, that the line is "plumb" and that may be all that is required. The difference between a makeshift plumb-bob and a well-finished one is that the one is balanced and the other is not. For general work, however, a more elaborate tool is necessary It is often convenient, when erecting large work in the pattern-shop or setting it in the foundry, to fasten a straight-edge on the face and drop plumb-bobs to a centre line on the floor from either end. Bobs for this purpose are required that will indicate points on the horizontal plane, and unless fitted with a steel point to resist the flattening effect of being dropped repeatedly they will not long be satisfactory.

The High Temperature Tensile Curve.*

By Douglas H. Ingall, M.Sc. (Wednesbury).

(*Abstract.*)

Because of a criticism on a Paper given on an allied subject before the same Society last year, the author has worked at three heating speeds (3, 8 and 20 deg. C. per min.) in place of one (20 deg. C. per min.). He showed that pure soft annealed copper wire was unaltered (that is, it gives a lower straight-line curve changing at a critical inflection temperature to a higher curved line) by the rates of heating used. For annealed silver, aluminium and copper the breaking temperature is not a linear function of the rate of heating.

Beyond the critical inflection temperature which terminates the straight line portion of the temperature-tensile curve the material is liable to creep or flow, with time, under very much smaller loads. For materials used at elevated temperatures, the ascertaining of the limit of the straight-line portion in industrial alloys is of great importance.

The second section of the Paper is devoted to a discussion on the tensile curves of some brasses. Pure metals, with the exception of aluminium, all gave one single loop for the higher temperature curve, whereas solid solution alloys gave a double loop. The experiments confirmed the importance of determining the limit straight-line portion of the temperature-tensile curve of industrial alloys. It is shown that for brasses up to 40 per cent. zinc there is a wide variation in this respect. Brasses containing copper to the extent of 88 per cent. or more than 97 per cent., or less than 75 per cent., will be suitable up to 250 deg. C., whilst composition bordering on 93 and 80 per cent. copper will only be satisfactory up to 200 deg. C. These figures explain the rapid breakdown of brass when used for blades for turbines running at high speed.

* A Paper read before the Glasgow meeting of the Institute of Metals.

Discussion on Mr. Melmoth's Paper on "Electrically-Produced Malleable Iron."*

Commercial Success Queried.

THE BRANCH-PRESIDENT (Mr. G. C. Pierce), after congratulating Mr. Melmoth, said that it was pleasing to note that there were some firms who were prepared to attempt to establish good, commercial blackheart malleable iron. He believed he was right in saying that formerly blackheart malleable iron castings were considered to be a type which could be produced successfully only in America, and one or two British firms, and all credit was due to Mr. Melmoth, and to Messrs. Lake & Elliot, for their efforts to establish a new commercial method of production in this country. Mr. Melmoth had expressed himself as satisfied that the castings could be produced commercially. He (the Branch President), however, without asking for any particular figures, would like to know whether Mr. Melmoth could give an assurance that these castings could be produced commercially, in competition with America.

MR. MELMOTH replied that, naturally, he based his statement on the ordinary purchase prices of malleable cast iron in this country. The issue raised by the Branch President, however, was altogether outside the scope of the Paper; it was far too large to be brought into the equation. The American schemes of production for malleable cast iron were not even approached in this country, from the point of view of magnitude, capital invested, and so on, all of which had a considerable influence on production costs, but he could say that it was possible, using a cheap base material, to produce malleable cast iron in this country which could find a market. That, he felt, was as far as he need go. If the costs of production were so high that the product could not find a market, then it was dead in any case, but if it were being sold every week to the extent that his firm were able to sell it at the present time, then it was obvious that it was being produced here commercially.

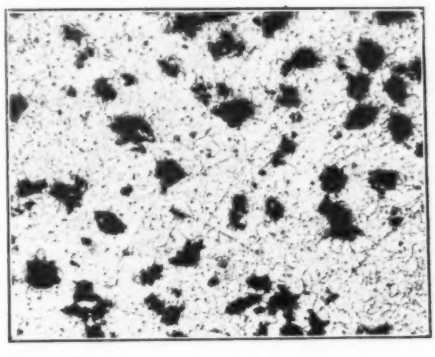


FIG. 1.

This section (x 50 dias) is of material of normal analysis and annealed in ordinary works conditions. Note shape of temper carbon is roughly nodular, and fairly evenly distributed. The test result was: Max. stress, 24.9 tons per sq. inch; elongation per cent. on 2 in., 20 per cent.; and cold bend, 1 in. x 5-16 in., 170 deg. unbroken.

High Temperature and Graphite Precipitation.

MR. V. C. FAULKNER said it was stated by the author in his excellent Paper that the details of the production of a white cast iron for the manufacture of malleable iron synthetically in the electric furnace were so well known that space need not be occupied in entering closely into them. He would like the author to give him the references for this "well-known" process, because he could not at the moment recollect a Paper on that particular phase of metallurgy, but he imagined, however, that the process would have, for its raw materials, steel scrap, anthracite and ferro-silicon. About a fortnight previously, in the German paper, "Stahl und Eisen," Professor Piwowarsky had published an admirable Paper showing that if iron, no matter whether it was white or grey iron, were teemed at a very high temperature—above 1,500 deg.—it became more grey; the writer had made special reference to this particular method of producing malleable, and said it had been found that, owing to the action of the electric arc, locally overheating the metal iron was liable to be produced which showed a certain amount of graphite, which, of course, was detrimental to the production of good castings. Continuing, Mr. Faulkner asked whether difficulty had been experienced as the result of the presence of chromium in the raw materials, *i.e.*, in the steel scrap, because an examination of the average scrap heap in Great Britain would reveal that there was a considerable quantity of chromium scrap amongst it.

The Process of Manufacture.

MR. MELMOTH said that when he had stated that the details of the production of a white cast iron synthetically in the electric furnace were well known he was certainly taking it for granted that, amongst the people engaged in the electric furnace trade this particular process was well known, Mr. Faulkner being included in that number. During the war a quantity of white iron was made here for replacing Swedish white iron. It was made entirely from wrought iron or steel scrap, carburised with anthracite coal, exactly as Mr. Faulkner had stated. Really there was very little in it. A base material somewhat suitable in composition—because one did not want to have to do much adjustment afterwards, although the composition might be corrected even if varied slightly—was melted down with an excess of carbonaceous material, such as anthracite; then a bath sample was taken in order to show the percentage of carbon, the silicon was adjusted by means of ferro-silicon, the slag put into condition, and the material tapped. It became difficult when, say, manganese were high in the initial scrap. Then one had to take advantage of the affinity, or increased affinity, for oxygen of manganese over carbon, and slightly oxidise the bath, in which case one put the manganese into the slag and brought it down in the bath to the required amount, afterwards pulling off the slag. There was no serious difficulty about the manufacture of the white iron itself. The effect of high temperature of casting, as stated by Mr. Faulkner, seemed to be a logical sort of statement. One of the things that had come to the front very much was the question of pre-heating moulds for the production of pearlitic cast iron. If the electric

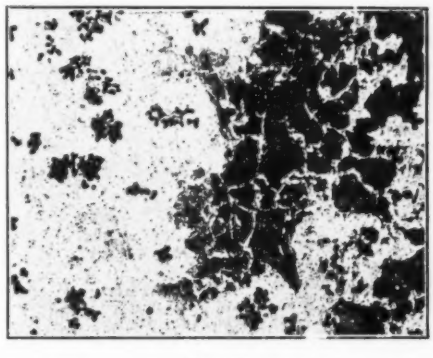


FIG. 2.

This section (x 50 dias) is of similar analysis to Fig. 1, and annealed under the same conditions. The packing material, however, was too oxydizing, and the defect of "banding" has been developed. The normal temper carbon and ferrite structure, shown on left hand portion of print, can be seen merging into a pearlite formation on right hand side. This was decidedly hard in machining. The test result was: Max. stress, 24.2 tons per sq. inch; elongation per cent. on 2 in., 8.5 per cent.; and cold bend, 80 deg. unbroken.

* This Paper appeared in out last issue.

furnace were permitted to utilise its full capability for heat—it was limited only by the refractories—the iron might become very much too hot. If that were the case, then that superheat, to his mind, would be used to pre-heat the mould during the period before solidification. A given composition, under those conditions, would produce graphite. In other words, a composition which, when cast into a cold mould, would give a white metal, and when cast into a hot mould would give a grey metal. He was satisfied, assuming the temperature were reasonable, perfectly white castings could be made. The test results alone should be sufficient to prove that; had primary graphite existed in those cases, it would have been a physical impossibility to have produced tests showing over 20 per cent. elongation.

Chromium in the Scrap.

With regard to the presence of chromium in the scrap, he had experienced that difficulty, and so would anybody who chose his scrap indiscriminately. A certain amount of care had to be shown in that connection, but it was possible to get scrap without chromium. That was one of the ordinary precautions which anyone who indulged in this particular method would have to take.

Blackheart versus Whiteheart.

Mr. J. W. Gardom, after thanking Mr. Melmoth for his lecture, said that during the previous

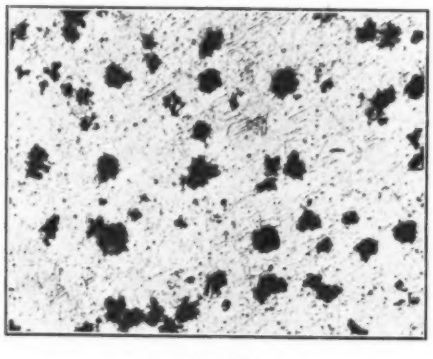


Fig. 3.

This section (x 50 dias.) has a normal analysis, and was annealed in same conditions as Fig. 1. The shape of temper carbon and its distribution are both very good. This is typical of the structures giving the very highest test results. The test result on bar was: Max. stress, 28.3 tons per sq. inch; elongation per cent. on 2 in., 26 per cent.; and cold bend, 180 deg. unbroken.

lecture an engineer had said that the foundryman did not know anything about his job, and now Mr. Melmoth stated that, owing to the irregularity of the material he had bought, he had had to make his own malleable. But when one had decided to make malleable, one had to decide whether to make blackheart or whiteheart. Mr. Melmoth had given a number of reasons why blackheart had been chosen. The first was that, under given conditions, the production of blackheart malleable was more certain than was the case with whiteheart. He (Mr. Gardom), however, did not think so. Actually, he was rather of the opinion that the production of blackheart was more difficult than the production of whiteheart. Quite a number of people did not share that view, for the reason, he believed, that blackheart was being made mostly in America, where they had spent much time and money on making it properly, and it was essentially a high-output product. That meant that a percentage of the production costs were given over to control, and that percentage was sufficiently high to allow of one or more skilled workers being employed on nothing but control. Unfortunately, most of the whiteheart malleable makers in this country were not able to afford that luxury. Again, he was afraid that most or many of the whiteheart makers were tempted, by the keenness of the engineer-buyer, to cut down their costs too much. They tried to cut their costs to meet competition, or the supposed competition, of other people, and in order to do that they cut out essential operations. That meant that they were lowering the quality of the product, and one could not blame the difficulties of manufacture, for instance, in that case.

Where Whiteheart Succeeds.

Another reason why Mr. Melmoth had decided to make blackheart malleable was that "the best results available in correct material of either type were of a higher standard in blackheart." Of course, test results could be made anything. One obtained higher tensile, elongation and bending figures with blackheart, but they were not everything. There was also, for instance, the question of rigidity. One did not get that property in blackheart to the extent that one did in whiteheart, and it was an essential property in many machines. Then there was the yield point, and a figure could be obtained with whiteheart which was from 2 to 4 tons higher than that obtained with blackheart. Also, the average of three Izod tests he had carried out was 7 ft.-lbs. for the blackheart and 8 ft.-lbs. for the whiteheart. The tests were made in the laboratory. Again, his firm (Messrs. Bagshawe, of Dunstable) had devised fatigue tests on malleable which was to be used particularly for axles. Part of an axle was mounted and rotated at a speed of 1,000 r.p.m., and a load was applied at the end.

It was practically the Wohler test, but not quite the same thing. The application of the load at that speed meant that there was an alternating

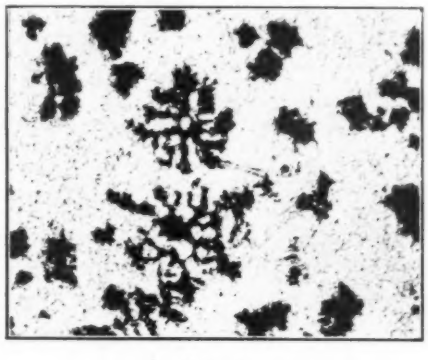


Fig. 4.

This section (x 50 dias.) was cut from a bar of rather abnormally high carbon content, namely, 2.66 per cent. Castings were white in fracture before annealing, so far as could be seen. The large, badly shaped temper carbon particles are characteristic of high carbon content, and are invariably associated with low tensile and elongation properties. Tensile result on bar: Max. stress, 22.2 tons per sq. inch; elongation per cent. on 2 in., 11 per cent.

load applied 2,000 times per minute—compression and tension. The tests were commenced with a given load, which was increased after a certain number of hours. The blackheart gave 14 kg. per sq. mm., and the whiteheart gave 15 kg. per sq. mm., and, for the purpose of comparison, it might be interesting to note that 0.30 carbon steel gave 17 kgs. per sq. mm.

He considered that the whiteheart made by his firm, at any rate, had a better machinability than other people's blackheart. It was, of course, a very difficult thing to evolve a test which would not produce argument, but, for a given feed and traverse, that whiteheart could be worked at about 120 ft. per minute, whereas blackheart which he had tested could only be worked at 100 ft. per minute. Also, for certain parts of electrical apparatus whiteheart was again better. Its resistance to corrosion was greater, and, for such things as electro-plating, and probably for galvanising as well, it was better than blackheart, and would certainly give a much higher polish if necessary.

It had been stated that the scope of applicability of malleable was decreasing rather than increasing, mainly owing to the extended use of steel castings, but later it was stated that the amount of superheat obtainable with the electric furnace made the production of light sections a comparatively easy matter. That meant that Mr. Melmoth was superheating the charge and so approaching the melting point of steel. What was the use, therefore, of making malleable? Why not had he made steel?

Consumption of Annealing Pans.

Continuing, Mr. Gardom asked at what temperature Mr. Melmoth opened up his annealing furnaces. As to the lecturer's reference to the very heavy consumption of annealing pans in whiteheart, he had his own ideas about that, and was not saying that the consumption was not heavy, but he would like to know the number of tons of annealing pans used in producing a ton of blackheart malleable. As to the statement that the temper carbon was produced as the temperature was lowered, he supposed Mr. Melmoth would agree that temper carbon was produced as soon as the A.C.1 point was passed, and, if that were so, he would also agree that temper carbon was produced very rapidly over the first period of the annealing operation, and that the rate slowed down more and more as equilibrium was approached. He believed he was right in saying that 75 per cent. of the temper carbon was produced in 25 per cent. of the time the material was held at annealing temperature. If that were so—and some people seemed to think it was—would it not be permissible, after the majority of the temper carbon had been produced in the form in which it was required, to raise the temperature so that the temper carbon was precipitated more quickly, and so cut down the annealing time, because in the remaining time the temper carbon produced could not destroy the initial formation?

As to the composition of the metal, as given in the paper, he was rather doubtful about the phosphorus content, and would rather have seen a little less phosphorus and a little more sulphur; but, for the composition given, what did Mr. Melmoth consider the best annealing temperature? Some notes had been given as to the mixing of the materials for annealing, and he asked Mr. Melmoth if he would give also the proportions they were mixed in.

Blackheart versus Whiteheart.

MR. MELMOTH, dealing first with his statement that, under given conditions, the production of blackheart malleable was more certain than was the case with whiteheart, said he was afraid he had judged whiteheart very largely by the published accounts of its behaviour, coupled with its behaviour in the machine shops of his firm. So far as the published accounts were concerned, one would imagine that people representing malleable firms would hardly write accounts in which they appealed for help, more or less, and state that they had questions which they could not solve, and, he believed, called upon the British Cast Iron Research Association to help them, if the production of whiteheart were quite so plain as Mr. Gardom would have them believe. So far as blackheart was concerned, America, undoubtedly, had already carried out a considerable amount of that investigation which was being asked for in connection with whiteheart. There might be, and probably were, quite a number of whiteheart foundries producing satisfactory malleable continuous, but apparently his firm were not buying their material from those foundries. The research carried out by the Americans had solved a number of questions, and one could almost predicate what was going to happen with a given temperature of annealing and a given analysis in a blackheart malleable casting, though not quite.

With regard to unreliability, he had mentioned that also; as the result of his own experience his firm were buying very large quantities of malleable iron and could get definite satisfaction for a time, but later something happened to the material, and, although probably many thousands of castings came through satisfactorily, maybe another batch gave very serious trouble. Matters would then be straightened out again, because, when anything went wrong, most of the makers knew what was the trouble and put it right, but after a time the unreliability factor again arose. That was honestly his experience.

As to the effect of the keenness of the engineer buyer, that applied equally to both blackheart and whiteheart, and one could hardly give favour to whiteheart in that connection.

Coming to the test results, he said Mr. Gardom's figures were very illuminating, but he did not know whether he had had a number of test results on blackheart to compare with those on whiteheart, or whether he was covering a very limited area. If the latter, his investigations were rather small, to say the least. The test results he himself had given were produced out of the ordinary oven, and not in the laboratory. The test bars were packed in the boxes with the castings and cast at the same time, and no special attention was given to them.

Rigidity or Brittleness ?

With regard to rigidity, Mr. Gardom had said that whiteheart was superior to blackheart in that connection. Exactly. "Rigidity" meant, *in proportion*, "brittleness." It must necessarily mean that. The more rigid a thing became, the less ductile it became. It was granted, therefore, that whiteheart had the greater rigidity. As to the test for fibre stress, which was an adaptation of the Wohler test, he did not quite understand the way in which the figures were given, because they were usually given as revs. under a given fibre stress load, so that he was not in a position to reply to that point.

Machinability.

As to machinability, here, again, Mr. Gardom's results were probably obtained on a few samples, and he was not prepared to question the figures. But, on the other hand, he saw no reason why the machinability of blackheart should not be quite equal to that of whiteheart castings. Mr. Gardom had referred to surface speeds, but he had not referred to the drilling of bosses. One of the troubles was that, although one could get a soft surface almost invariably in whiteheart, as soon as the sections thickened, the trouble began.

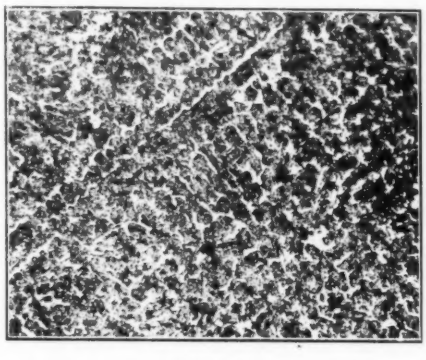


FIG. 5.

The bar (x 50 dias.) from which this section was cut was specially prepared in the laboratory to show the effect of shortened period of annealing. It is of normal analysis, and was taken quickly to 850 deg. C. and held 30 hours, afterwards cooling fairly rapidly. The original white iron structure has largely persisted. Cementite has been only partially taken into solution, and odd small areas of temper carbon produced. Fracture was quite steely, with small dots of temper carbon, and the material not commercially machinable.

Galvanising.

Where galvanising was concerned, he agreed that whiteheart won every time. The temperatures at which it was carried out were not by any means good for blackheart, although it could be done under reasonable conditions, with special reference to temperature.

Replying to the question as to why he had not made steel instead of malleable, he said that he *was* making steel. But malleable was called for, and, with the base material which was being used, and various other factors, he believed malleable could be produced cheaper than steel. The temperature at which the annealing furnaces were opened up was about 650 deg. C.

Annealing Pan Consumption.

With regard to annealing pans, he could not give accurate figures of weights of pans per ton of castings. His remarks had been based largely on comparisons of the appearance of annealing pans, and of whiteheart furnaces against blackheart furnaces after being drawn. He believed that Mr. Hurren had given a figure of 12 cwts. for every ton of castings he had produced in the

Rover Company's foundry, but the figure was nothing like so big in blackheart work.

As to whether it was permissible to raise the temperature when the bulk of the temper carbon was precipitated, he said it was permissible, but he had run these furnaces up, holding them, on heating, at about 750 deg. C., and afterwards rising to full temperature, in order to allow a certain amount of temper carbon to precipitate itself at the lowest temperature, and to get the greatest amount of fine grain. But it was not only temper carbon that entered into the problem. When the higher temperature was reached, the ferrite structure would be affected, which would mitigate against high elongation.

Influence of Sulphur.

As to sulphur, the action of that on iron carbide was fairly well known. Sulphur tended to retain carbon in the combined condition. It was just as easy to take it out as to leave it in, and he had taken it out. In the whiteheart process he fully appreciated the significance of it, but in the case of blackheart its significance was altogether the opposite, and, consequently, the more he could get out the better.

Annealing Temperature.

The highest temperature was in the neighbourhood of 850 deg. C. It could be raised to 900 deg. C. fairly safely, but—and he ought to have mentioned this in the Paper—it was proportional somewhat to the total carbon content of the material. If that content were on the high side, a lower annealing temperature could be used, and *vice versa*.

Packing Material.

The proportions of annealing material were not by any means fixed. Assuming that the packing material showed signs of being on the oxidising side, he would more or less dilute its oxidising capabilities by adding material of a non-oxidising character, so as to keep it at all times as near a non-oxidising material as could be obtained—it never could be absolutely non-oxidising.

Mr. H. O. Slater, though he claimed to be one of the first in London to interest himself in the production of malleable, said he had not produced it for ten years, during which time, no doubt, a great deal of progress had been made. He had always held the view that the electric furnace would be far superior to any other melting medium for malleable iron. The malleable iron business was one in which he was convinced science must march hand in hand with practice. There had been things which had absolutely puzzled the practical man in connection with annealing and with melting. The test figure given by Mr. Melmoth had surprised and pleased him. Ten years ago he had prided himself upon producing a test piece with a tensile strength of 24 tons, and, he believed, with an elongation of 4.7. Metallurgists would no doubt say that the material was on the hard side. It was, but it was perfectly machinable. As to the construction of the oven used by Mr. Melmoth, he asked where the oven was fired from, and where the dampers were situated.

Mr. Melmoth said, with regard to the ovens, there were two types, both fired from the end, with longitudinal flues and side ports. In both cases the ports were about 1 ft. above the level of the ground, and each port was dampered. The ovens had a firebox only.

Cost of Blackheart.

Mr. G. Bagshawe asked if the cost of melting of malleable iron by the blackheart process in an electric furnace compared favourably with other forms of melting, and, if so, how many melts Mr. Melmoth must get from the same furnace per day, presuming he started from the cold in the morning, in the ordinary way. The pan costs were very high, and the fact that they were high in malleable iron production was frequently not recognised. The annealing temperature for blackheart malleable had been given by Mr. Melmoth as about 90 deg. C.; he himself was under the impression that that was higher than the American annealing temperature, and very nearly approaching the English. If that were so, he could not quite see where the advantage was. American malleable was produced nearly 25 per cent. cheaper than English, and that was the secret of the success of malleable production in America. They were able to sell 4 tons where we were selling 3. A very considerable part of the 25 per cent. was due to the larger quantities produced. Would the electric process of melting, in Mr. Melmoth's opinion, help to bring the English costs down to somewhere near the American costs, and thereby increase the production, in spite of the fact that we had very much smaller quantities to deal with? It was a difficult question, but it presented a possibility, not only to the malleable iron founder, but to everybody in the country who used the product, such as, for instance, motor car manufacturers, who were probably the largest users in America at the present time. He believed that the American motor car manufacturers used more malleable than the railway people. In England, the quantity of malleable used for railway work was negligible.

Mr. Melmoth said that the number of heats taken per day out of a furnace, admittedly, must, practically speaking, control the cost of production of the material, and it had to be admitted from the beginning that enough must be demanded to keep a furnace in satisfactory working trim. His firm were rather preferentially situated. Their electric furnaces were melting steel, and could be turned over to malleable as and when required. Normally, they would perhaps take out three charges in an ordinary working day, and on that basis he failed to see why it should be expensive. His remarks in that connection, however, might be somewhat biassed, in view of the fact that the electric furnaces were used for both steel and malleable. The question as to whether the electric method of making blackheart malleable iron would enable the product to be sold at prices similar to those of the American product was one which would require a good deal of thought before it could be answered. His paper was not written with a view to suggesting that Britain could produce blackheart malleable more economically from the electric furnace than from any other melting medium. He was not saying that it was not commercial, because it was; he was quite sure of that, but to suggest that we were going to knock the bottom out of other people's costs was absurd, and had never been hinted at. Mr. Bagshawe had answered his own question when he had said that the greater part of the difference between the American and English prices was due to the enormous outputs attained in America. Bulk production was the method of producing cheaply, but a significant feature was that the Americans appeared to be developing a process of manufacture of blackheart malleable by what appeared to be an even more complicated and expensive system—he would call it a triplex system. The Americans, who were some of the biggest malleable makers, were developing that process and apparently making ends meet, and yet they used a cupola, a converter, and an electric furnace; so that it appeared that the electric furnace was finding its way into the American blackheart malleable trade. With regard to Mr. Bagshawe's remark that malleable was not used on the English railways at all, but that it was on the American railways, he asked whether that was due to the American malleable being more suitable for use on railways than the whiteheart.

Pearlitic Cast Iron.

Mr. Graves referred to a lecture delivered before the London Branch last session on pearlitic cast iron, in which it was stated definitely—if his recollection was correct—that there was a marked tendency nowadays for pearlitic cast iron to take the place of malleable. The tensile strength of pearlitic cast iron was given as 24 tons per square inch, and, for the purpose of comparison, he asked Mr. Melmoth if he could give the tensile strengths of blackheart malleable castings.

Mr. Melmoth replied that whoever had made that statement had made a very wild one. Undoubtedly, pearlitic cast iron had its own field, but he himself did not feel, although he was open to conviction, that pearlitic cast iron would cause the malleable makers to sleep less soundly. After all said and done, no matter in how many frills it was wrapped, being cast iron, it had a portion of the defects which were inherent in cast iron;

i.e., it could not, under any condition of manufacture, possess the proper degree of ductility. It possessed a most unusual tensile strength, but it did not possess the normal toughness or elongation properties of a good malleable iron.

Vote of Thanks.

MAJOR SMALL, proposing a vote of thanks to Mr. Melmoth for his paper, said it had provoked a most interesting discussion, and he did not think anybody could have replied to criticisms in a more straight-forward a manner. What he had always found rather difficult to understand, however, was why we in this country should admit the fact that America beat us on costs and in many cases the finished product. It seemed to him most extraordinary that this subject of mass production was so constantly raised, and that the whole of Great Britain, including skilled foundrymen, should sit down quietly and accept the position. Could not Britain produce anything in the foundry business and be first in the field in such a sphere of commerce? Finally, Major Small again thanked Mr. Melmoth for his paper and the discussion it had provoked.

MR. ASHWELL, seconding the vote of thanks, also referred to pearlitic cast iron. He said his firm had experimented on a similar type of iron. They had electrically heated a cold mould, had raised its temperature to a certain point, and poured ordinary cast iron into it. The mixture consisted of old gas stoves and other scrap, with 5 per cent. of pig-iron and silicon and phosphorus, and a satisfactory casting was produced. Recently he had been to Germany for six weeks, and had brought back with him a sample of pearlitic cast iron made there. That casting, and the one already referred to as having been made by his own firm, were subjected to certain tests, and the latter broke under the tensile test at a stress which was 75 lbs. higher than that at which the German casting broke. Malleable iron originated in England, and it was thrown back on another country to produce as a commercial product, because our own country would not find the money, and the same thing was happening to-day. We could not find the money to produce articles which originated from British brains, and there might be many present at that meeting whose forefathers had had to give their ideas away to other countries, whilst the latter had sold them back to this country at extravagant prices.

MR. J. W. GARDOM, who supported the resolution, said that, although he had a great respect for Mr. Harren, as, indeed, had everybody else, he was quite wrong when he had said that malleable was going out. He hoped Mr. Melmoth would go on with his work and would give more information about it later. His criticisms that evening had been made solely for the purpose of creating discussion and obtaining information.

The vote of thanks was carried with enthusiasm.

MR. MELMOTH acknowledged the vote of thanks and expressed his gratitude. He could not allow Major Small's remarks to pass without comment. Major Small had asked repeatedly when English foundries were going to do something, but, with all respect, he would suggest that Major Small might read metallurgical history. He would then find that the steel trade, and no doubt the iron trade also, had been definitely in the forefront in doing things, although it must be admitted that the almighty dollar had been able to develop those things to a greater extent than had the more subdued English pound. That, however, did not alter the fact that the discoveries had been made in English foundries. In many cases the initial credit was due to this country. There was a lot in Mr. Ashwell's statement that we could not get our processes financed. It was very difficult, particularly at the present time, for any firm in this country to finance any big scheme calling for a large outlay, and it was not altogether in their hands. Whilst accepting the vote of thanks with very great gratitude, he thanked Mr. Gardom personally for his energetic contribution to the discussion.

THE SECOND ANNUAL DINNER of the Wolverhampton Engineering and Scientific Club was held last week, when Vice-Admiral Sir G. C. Goodwin was the principal guest. During the evening Mr. Snow (hon. secretary) mentioned that there were now 240 members on the books.

Safeguarding Aluminium Ware.

The inquiry into the application of the aluminium trade for protection under the Safeguarding of Industries Regulations, was opened at the Board of Trade on Monday. The application was made by the British Aluminium Hollow Ware Manufacturers' Association, represented by their chairman, Mr. R. C. Rodgers, and was opposed by Service Supply, Limited, who were represented by Mr. N. L. Macaskie.

Mr. R. C. Rodgers, the first witness, said he represented twenty-three manufacturers, whose works were widely scattered over the Midlands. The application was in respect of all domestic utensils made of aluminium and of parts thereof. He gave figures showing that imports from Germany had increased since the protection granted under the 1923 Act, and indications were that unless the application were successful the market would again be flooded with dumped German goods. The highest wages paid to workers in the industry in Germany were 7d. per hour, while in this country skilled operatives received from 1s. 4d. an hour upwards. They submitted that in the heavier-gauge goods Germany had a basic advantage of 33⅓ per cent., while in the lighter grades the advantage was 50 per cent.

For six months they had been working three-quarter time, which they considered a better way than working three weeks full time and closing the factory for the week. In the ten firms from which they had figures there were 1,300 people employed in 1920, while now there were only 890.

Speaking for himself, said witness, he could employ 200 to 300 people in normal conditions, but he was now able to find employment for only 100 men and women. There were 63 per cent. of skilled workers among the male employees, and of the female workers 50 per cent. were skilled. Fully skilled male workers were paid 1s. 6½d. per hour, and unskilled 1s. 2d. to 11½d., while female skilled hands had a rate of pay of 8d. per hour and unskilled 6d. per hour. The maximum rate for skilled male workers in Germany was 61 pfennigs, equivalent to 7d. per hour. Practically every other country in the world had a tariff against our aluminium hollow ware, only Australia and New Zealand giving us a considerable preference. The duty on such goods entering America had recently been increased from 20 per cent. to 40 per cent.

The demand for aluminium ware, continued witness, was increasing all over the world, but we were not holding our own in it. We could not hold our own in this market, so how could we hope to in the markets where there was a tariff against us? "The only place where we are holding our own," he added, "is in those markets where they give us a preference, and I may add that they show signs of getting tired of sheltering an industry which we ourselves do not shelter."

Questioned by Mr. Macaskie, who appeared in opposition to the application, witness said they did not rely on the volume of employment provided to make the industry one of substantial importance, but on the goods produced. He agreed that 1920 was a very good year, and that they exported 327 tons of their produce and sold 1,050 tons in this country. In that year the imports of German aluminium hollow ware were 351 tons, 272 tons of which was in the first three quarters of the year. In the first three quarters after the duty was taken off imports from Germany totalled 304 tons. He regarded the latter figure as constituting an abnormal figure.

Iron and Steel Output in September.

The National Federation of Iron and Steel Manufacturers report that the production of pig-iron in September amounted to 448,700 tons, compared with 444,500 tons last August and 569,200 tons in September, 1924. There was at the end of the month a net reduction of seven in the number of furnaces in blast compared with the number at the beginning of the month. The September production included 117,200 tons of hematite, 157,200 tons of basic, 124,500 tons of foundry, and 19,500 tons of forge iron.

The production of steel ingots and castings in September amounted to 638,900 tons compared with 477,100 tons in August (when production was affected by the summer holidays) and 645,000 tons in September, 1924.

MR. ROBERT BALLANTYNE, of Whittingehame Gardens, Kelvinside, Glasgow, died on October 9. Mr. Ballantyne was a director of Stewarts & Lloyds, Limited.

XUM

Trade Talk.

FAULKNER & WINSOR have removed from 147, Fenchurch Street, London, E.C.3, to 48, Fenchurch Street, E.C.3.

JOHNSON & PHILLIPS, LIMITED, have an order from the Victorian State Electricity Commission for 19 transformers of 3,000 k.v.a. capacity.

WILLIAM PRESTWICH & SONS, LIMITED, have acquired the business of William Lee & Sons, Limited, Spring Foundry and Montrose Works, Dronfield.

NEWTON, CHAMBERS & COMPANY, LIMITED, of the Thorncliffe Ironworks, Chapeltown, near Sheffield, have orders in hand aggregating in value £150,000 for cast-iron houses.

THE QUARTERLY MEETING of the London Iron and Steel Exchange was held on October 20, when Mr. H. J. Skelton gave an address entitled "The Outlook for the British Iron Trade."

MR. F. G. OGLESBY, metal buyer for Bronner, Mussett & Company, has established a business under the style of F. G. Oglesby & Company, Limited, at 82, Mark Lane, London, E.C.

THE ARMSTRONG CONSTRUCTION COMPANY, LIMITED, have been instructed by the Air Ministry to erect at Karachi one of the largest airship sheds in the world. The whole of the steelwork will be made at the company's works at Germiston, Glasgow.

AN OFFER IS TO BE MADE to sell by public tender the property of the Blyth Shipbuilding and Dry Dock Company, Limited. The company own a yard with six shipbuilding berths and five dry docks. The works are served by a system of steam and electric travelling cranes, and are electrified throughout. Connection with the L.N.E. Railway is effected by means of a siding, which branches off the railway lines at the South Blyth coaling staithes.

IN THE BRAMCOTE SAND QUARRIES of the General Refractories Company, Limited, of Sheffield, there has been rediscovered, quite by accident, the "Dale" bed of iron foundry sand, the excellent quality of which largely assisted in the rapid development of the foundry industry in the Nottingham and Derby districts in early Victorian times. For many years now this sand has been unobtainable, and has been considered to be exhausted.

THE RITSON SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, of Blyth, is in process of being offered for sale. The company was founded in 1919, and has engaged solely in ship repairing. The works occupy altogether 22 acres, and are situated immediately to the north of the Blyth Shipbuilding Company's premises. The ship-repairing section of Messrs. Ritson's undertaking has a river frontage of 700 ft. There are no dry docks.

THE VICKERS SPEARING BOILER COMPANY, of which Vickers, Limited, are the sole proprietors, will in future be known as the Vickers Boiler Company, Limited. The management of the company will comprise Mr. Douglas Vickers, chairman (chairman of Vickers, Limited), Sir Vincent Caillard, D.L., director (director of Vickers, Limited); Commander C. W. Craven, R.N., director (director of Vickers, Limited); Mr. W. F. Sadler and Mr. J. Kerr Bock, joint managing directors; Mr. G. T. Williamson, general manager; and Mr. H. B. Clark, secretary. The address of the new company is 20, Kingsway, London, W.C.2.

AN ORDER for motor-car parts, to the value of over £300,000, has just been secured by the Moss Gear Company, Limited, of Aston, Birmingham. Considerable benefit will accrue to the nickel chrome steel industry of Sheffield and district, and also the Midland stamping trade. Referring to the circumstances under which his firm had been led to extend its factory and provide for 500 additional hands, Mr. W. Duckett, the managing director of the Moss Gear Company, said that the motor-car industry had been greatly strengthened by the increased turnover which the reinstitution of the McKenna Duties assured. Thanks to the increase it had been possible to reduce production costs, and the prices to the public had likewise been reduced. Prices of gears and other components had fallen by 10 to 12½ per cent. since last autumn.

THE ACTION of the Cleveland mineowners in not insisting on reductions of wages indicates the great generosity shown to the men in periods of difficulty. The ascertained prices of pig-iron showed a fall from 76s. 5.21d. to 71s. 4.11d. per ton, a difference of 5s. 1.10d. In normal circumstances the decline in prices would have enabled the owners to reduce wages by the equivalent of 6.3 per cent. on the base rates. Had the owners decided that wages should be paid strictly according to the agreed scale, they would have been entitled, on the ascertained prices for the quarter, to lower the wages by 11.4 per cent. For the second time, however, they agreed to forego any reduction, and wages thus will remain unaltered for the next three months. Including the 5 per cent., usually allowed by the owners, wages now stand 16.3 per cent. above the scale.

Contracts Open.

Grange-over-Sands, October 26.—Pipes and fittings, for the U.D.C. Mr. T. Huddleston, engineer, Council Offices, Grange-over-Sands.

Johannesburg, December 3.—Crane for the South African Railways and Harbours. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. A.X. 2,459.)

Oban, October 17-29.—Main, etc., for the Lorn District Committee of the Argyll County Council. Mr. W. Macdonald, engineer, Columba Buildings, Oban. (Fee £2 2s., returnable.)

Newport, Mon., October 28.—Pumping plant, for the Corporation. Mr. A. N. Moore, borough electrical and tramways engineer, Town Hall, Newport, Mon. (Fee £3 3s., returnable.)

Gazette.

MR. C. H. SMITH, consulting engineer, Monkseaton, appeared for his public examination at Newcastle Bankruptcy Court. Debtor's statement of affairs showed liabilities expected to rank at £7,160 and assets expected to produce £1,896, leaving a deficiency of £5,264. The cause of his failure, debtor said, was his being called upon to pay the amounts of the guarantees in respect of two ship-repairing companies of which he had been a director. The examination was adjourned until November 19.

AT STOURBRIDGE Bankruptcy Court the public examination has been held of J. B. Share, of Wollaston, Stourbridge, carrying on business as iron, steel and metal merchant, at Mill Street, Brierley Hill, under the name of James Bertram Share, and also under the name of The Brierley Hill Motor Transport and Engineering Company. The statement of affairs showed liabilities of £10,490 gross and £7,722 expected to rank for dividend, and the assets were £715, leaving a deficiency of £7,007. Failure was said to be due to depreciation of stock, machinery, etc., bad trade in the last three years, and heavy losses on the motor transport business. The examination was adjourned for debtor to furnish a cash and goods account.

Personal.

MR. E. JOLLEY is the new president of the Stoke-on-Trent Association of Engineers.

MR. J. A. D. MCBAIN has been elected a director of the Glenboig Union Fire-Clay Company, Limited, in place of the late Mr. Craig.

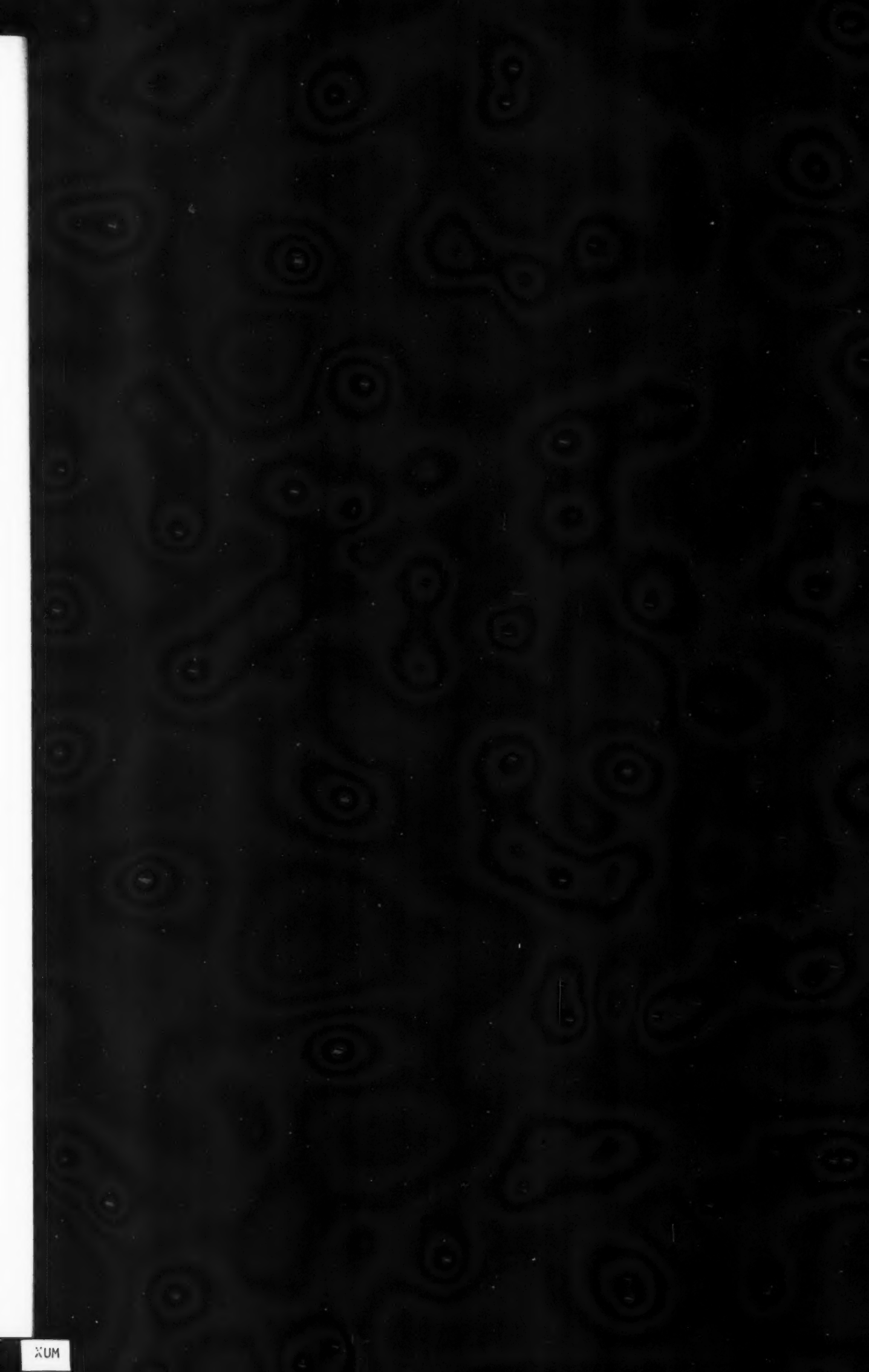
MR. T. R. ELLIN, head of the firm of Thomas D. Ellin, Limited, Footprint Works, Sheffield, was installed Master Cutler at the Court House last week. He is the fourth member of his family to be elected to this high honour. The outgoing Master Cutler (Mr. W. W. Wood) presided over the ceremony of installation and among those who supported him were Mr. David Flather (Senior Warden), Mr. P. W. Lee (Junior Warden), Sir William Ellis, Sir Albert Bingham, Messrs. M. J. Hunter, W. F. Osborn, H. H. Bedford, W. Clark, R. W. Matthews, J. Neill, and Colonel H. K. Stephenson.

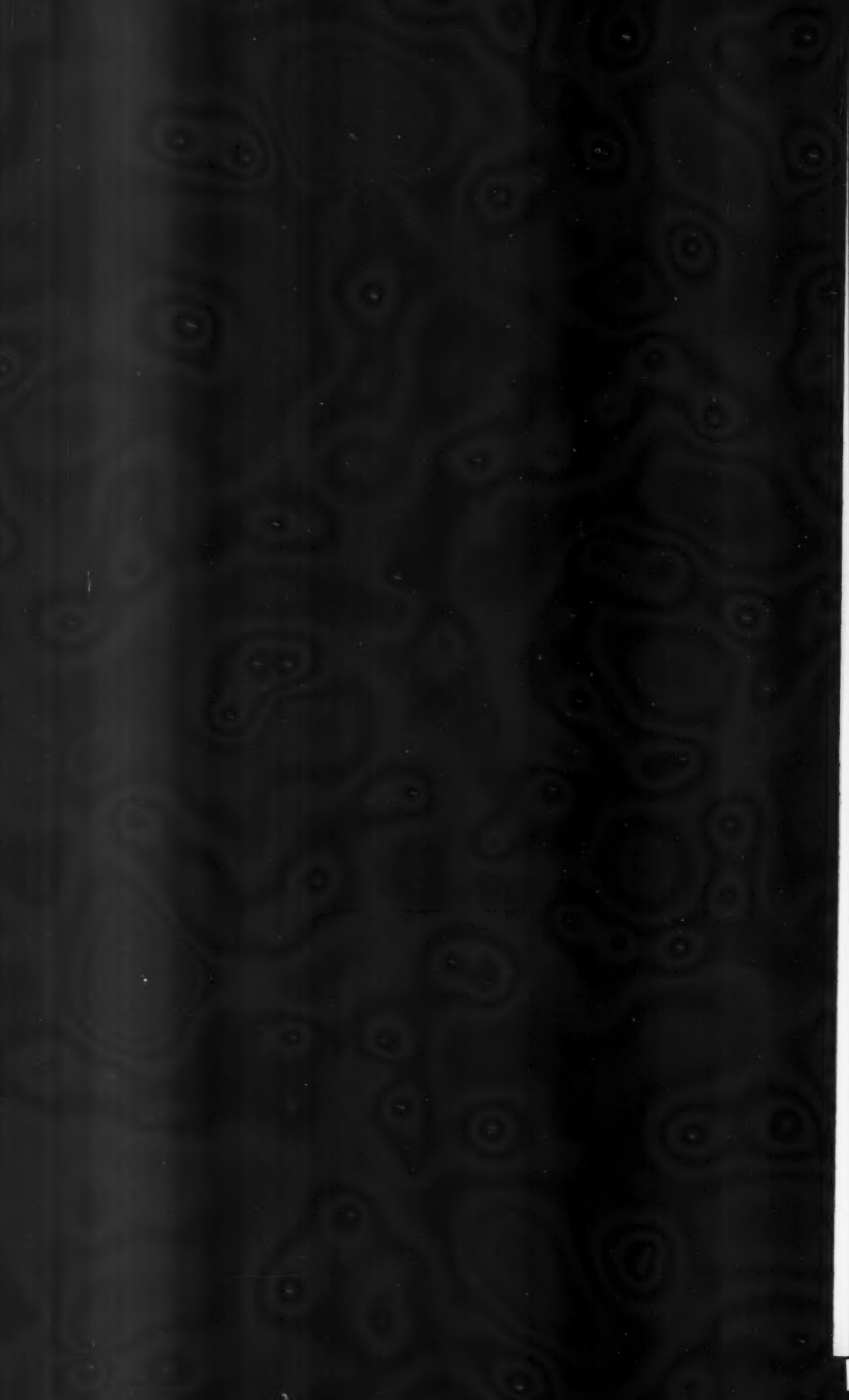
Wills.

TAY, H. P., of Kings Norton, Birmingham, wire manufacturer	£23,560
CATTELL, J. H., of the Hawthorns, Waterloo Road, Wolverhampton, sheet metal manufacturer	£71,647
TISDALL, A. D., of Chevin, West Byfleet, Surrey, a director of Naylor, Benson & Company, Limited, iron ore merchants, Abchurch Lane, E.C.	£13,944

THE GLENBOIG UNION FIRE-CLAY COMPANY, LIMITED, have purchased the Glenboig estate, including the clay field, for the sum of £17,000.

DR. L. AITCHISON, in his presidential address to the members of the Birmingham Metallurgical Society on Friday last dealt with the subject of metallurgical training. The metallurgist must be trained, he said, on both the theoretical and practical side, and the real metallurgical training that was required now-a-days was the one that forced the academic student to realise that metals were locomotives, motor-cars, steamships, bridges and aeroplanes, and at the same time enabled the foundrymen to understand that metals were complicated and yet simple and ordinary arrangements of different atoms and molecules with definite and persistent characteristics.





Sterling

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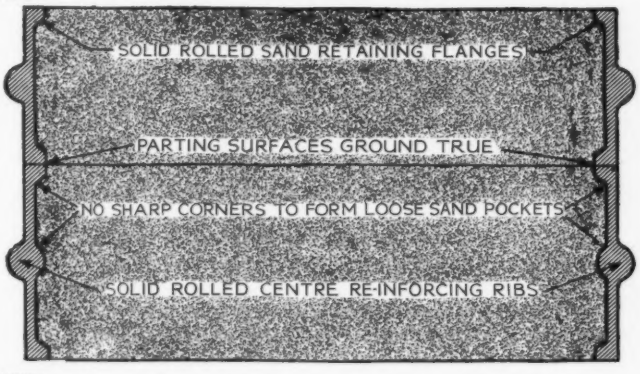
WHY ROLLED STEEL? BECAUSE A ROLLED SECTION MEANS A ROBUST SECTION

Observe the accompanying illustration. Notice the solid nature of the walls of the Box with their centre reinforcing ribs. Notice also how the parting surface—a very important part of the box but a part nevertheless always open to receive inadvertent bangs and blows—is, in the Sterling Box backed by a deep solid ledge or flange all around the Box. The shape of this ledge is your safeguard for a permanently accurate parting and its strength can *only* be obtained by rolling the section.


SOLID ROLLED SAND RETAINING FLANGES
PARTING SURFACES GROUND TRUE
NO SHARP CORNERS TO FORM LOOSE SAND POCKETS
SOLID ROLLED CENTRE RE-INFORCING RIBS

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SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
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Telegrams: "LOWOOD, DEEPCAR."

XUM

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Although the demand for Cleveland iron on home consumers' account continues much below the average at this period of the year, it is, at all events, satisfactory to report that export business is distinctly on the mend, due in no small measure to the substantial order for special foundry quality recently booked for America by Pease and Partners, Ltd., amounting to some 35,000 tons, for delivery over the next twelve months. More hopeful still is an intimation that this contract is the precursor for further large orders in the same direction, which points to a very welcome expansion of Tees-side export trade in the near future, which must inevitably have a favourable effect upon a much-tried British industry. An immediate result of the American order has been to bring into the market a number of consumers, who have been holding back and have now come to the conclusion that further delay may be dangerous. Sellers, however, were not disposed to make any further concession, and adhered firmly to the previous figure for No. 3 G.M.B., viz., 66s. 6d. per ton. On this basis No. 1 was offered at 69s. 6d., No. 4 foundry 65s. 6d., and No. 4 forge 65s. per ton. Export business with the Continent remains very dull and unchanged, but sales to Scotland are better, the difference in price between Cleveland and foreign foundry iron being now barely sufficient as a set-off to the inconveniences and delays suffered in the matter of deliveries.

The Tees-side hematite market fully maintains the improvement recently noted, the home demand being on an expanded scale, which in conjunction with an enlarged inquiry from the Continent, has imparted a more active tendency to business. Prices are consequently a shade firmer, with East Coast mixed numbers quoting 74s. 6d. per ton and No. 1 quality 75s. per ton. On the North-West Coast Bessemer mixed numbers are quoted at £4 to £4 2s. 6d., c.i.f. Welsh ports, £4 4s. per ton delivered at Glasgow, £4 7s. 6d. per ton delivered at Sheffield, and £4 12s. 6d. per ton delivered at Birmingham.

THE MIDLANDS.—In this area the chief consumers of foundry iron are the makers of light castings, who are fairly busy, but the heavy ironfounders, where bulk tonnage is usually sent, are very poorly situated at the present juncture. Lincolnshire No. 3 iron is not now competitive, only small quantities coming into the district.

Finished Iron.

Reference has already been made to the keen competition from which South Staffordshire makers are suffering. Since the working arrangement which secured to each district its own prices came to an end recently, crown bars made in other districts have been sold in South Staffordshire at as low as £11 10s., and common bars at £10 10s. This is a very severe blow to local makers, whose market is more or less restricted and who have not now the turnover to fall back upon which some of their competitors enjoy. Under the circumstances it is rather difficult to name a price for bars made in this district. For newspaper purposes manufacturers would put out £12 and £11 as the quotations for the two qualities, but, of course, it is very obvious that prices such as these are no earthly use except under special circumstances, which would make them not representative of the market. Exactly how much less would be accepted it is impossible to say, everything depends on the circumstances connected with any particular transaction. With falling production costs and greater competition, however, it is impossible to maintain anything like the old prices. Unfortunately, volume of turnover is so very difficult to obtain in these days when demand is so restricted and there are so many keen competitors.

Metals.

Copper.—A steady buying movement may be noted as the chief feature of interest in the market for standard copper of late, and recent values have been well maintained. Consumers are now showing greater interest in the metal, and numerous inquiries are on the market for casting and electro, with business put through over the next six months. There is little doubt that consumers have allowed their reserves of metal to become largely depleted, and they are now buying October-December metal very freely. Current quotations :—*Cash* : Thursday, £62; Friday, £62: Monday, £62; Tuesday, £61 17s. 6d.; Wednesday, £61 15s.

Three Months : Thursday, £62 17s. 6d.; Friday, £62 17s. 6d.; Monday, £63; Tuesday, £62 15s.; Wednesday, £62 12s. 6d.

Tin.—The recent rapid recovery in tin values has since been accelerated by the reappearance of good American buying orders and the excellent statistics issued for September, according to which the visible supply was reduced by about 2,400 tons in the neighbourhood of 17,000 tons. At the same time, the total deliveries for September were very good, totalling 9,855 tons, including the American outgoings of 6,360 tons, which were but little under those for the previous month. Current quotations :—*Cash* : Thursday, £280; Friday, £277 15s.; Monday, £279 15s.; Tuesday, £280 5s.; Wednesday, £280 15s.

Three Months : Thursday, £280 10s.; Friday, £278 10s.; Monday, £280 5s.; Tuesday, £280 10s.; Wednesday, £280 17s. 6d.

Spelter.—Values of this metal continue to steadily advance, and at £40 per ton have reached the highest level recorded during recent years. Production being rather short, with but little offering either from America or Belgium, the tendency of the market favours still more stringent conditions. The statistical position of the metal appears sounder than that of any of the other non-ferrous metals, stocks in America having been reduced to practically one week's supply. Current quotations :—*Ordinary* : Thursday, £40 7s. 6d.; Friday, £40; Monday, £40 2s. 6d.; Tuesday, £40 3s. 9d.; Wednesday, £40 3s. 9d.

Lead.—The market for soft foreign pig is the only section excepted from the general advance in prices of non-ferrous metals. Actually consuming demand appears to have become somewhat slower since last writing, and the fluctuations in values have undoubtedly been due to professional influence. Of course, consumption is still heavy, and the American position is undoubtedly very firm, but users are naturally more reluctant to cover their needs at what they consider to be the seriously inflated level of values. Current quotations :—*Soft foreign (prompt)* : Thursday, £39 7s. 6d.; Friday, £38 15s.; Monday, £36 17s. 6d.; Tuesday, £39; Wednesday, £38 11s. 3d.

Luton Labour Dispute.

An unusual labour dispute, for which neither the employers nor the men were responsible, occurred at the Luton works of the Davis Gas Stove Company, Limited, on Wednesday of last week. It arose over the breakdown of the electrical plant, and through the refusal of the firm to pay the piece workers for time lost; 340 men came out, these affecting eight sand moulders, seven cupola hands, 40 iron dressers, 18 labourers and 30 core makers, who would not return after the dinner hour.

On Friday, Mr. E. G. Logan, of the Central Ironmoulders' Union, met the men, and was one of a deputation to wait on Mr. H. N. Davis, managing director, and Mr. W. R. Blair, secretary of the National Light Castings' Federation, to which the firm belong. Mr. Davis said he was bound by a Federation agreement, made in 1914, which exempted employers from payment of compensation due to accidents arising from a cause over which they had no control. The representatives of the workers then submitted a proposition for a temporary arrangement being made by which the men would receive a little compensation pending a meeting between the Federation and the Ironmoulders' Union executive.

This proposal was accepted by Mr. Davis, who made the concession conditional on the men returning to work immediately. The terms of the proposal were also accepted by the men, and the immediate effect of this was that the men returned to work on Saturday morning.

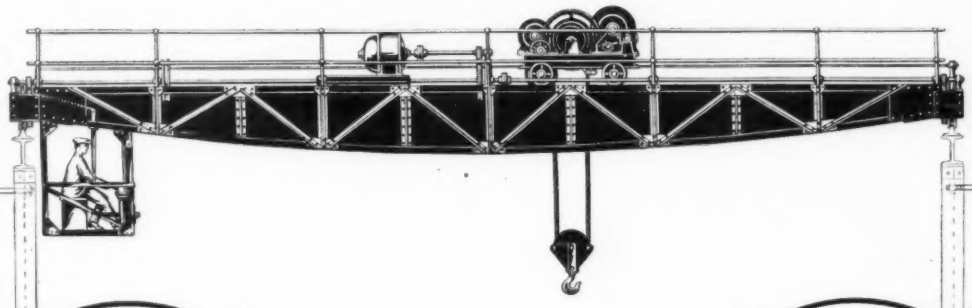
New Companies.

Comelybank Foundry Company, Limited, Comelybank Foundry, 103, Broad Street, Denny, Stirlingshire.—Capital £2,000 in £1 shares. Ironfounders, brassfounders, engineers, etc. Directors: J. C. Wright, T. Wyper, J. Waddell, and three others.

Liverpool Castings and Tool Supply Company, Limited, 41, South Castle Street, Liverpool.—Capital £1,200 in £1 shares. Tool and scientific instrument dealers, etc. Directors: W. R. Driver (permanent) and J. W. Driver.

Swinson's Engineering Works, Limited, Marlborough Court, Princes Street, Belfast.—Capital £2,000 in £1 shares. Engineers, founders, millwrights, etc. Solicitors: Crawford & Lockhart.

"BROADBENT" FOUNDRY CRANES



As supplied to ALL THE LEADING STEEL & IRON FOUNDRIES THROUGHOUT THE COUNTRY

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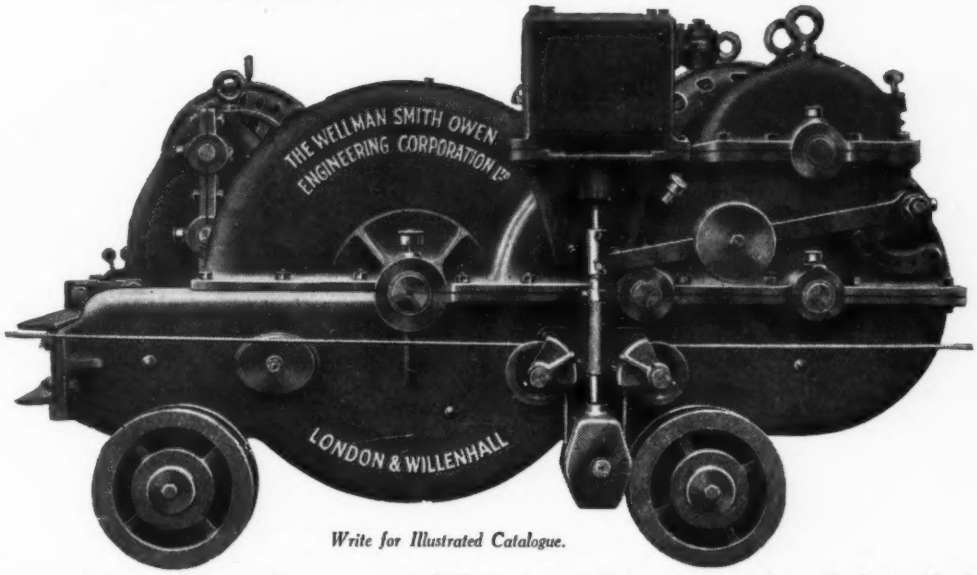
THOMAS BROADBENT & SONS LTD.
HUDDERSFIELD.
Established over 60 Years

Our Cranes are of ROBUST CONSTRUCTION and can be RELIED UPON to give a LIFETIME'S SERVICE.

WELLMAN TOTALLY ENCLOSED CRANE TROLLEYS ARE IDEAL FOR FOUNDRY CONDITIONS



Write for Illustrated Catalogue.

Not only are all working parts entirely protected from the grit and dust of the atmosphere, but the efficient lubrication and smooth running which can be obtained are highly conducive to long life of the Crane.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

Telephone : HOLBORN 2588/9 — **36-38, Kingsway, LONDON. W.C.2.** — Works :: :: DARLASTON, South Staffs. — *Telegrams :* "Principium, Westcent, London."

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	61 15 0
Three months	62 12 6
Electrolytic	67 5 0
Tough	63 10 0
Best selected	64 0 0
Sheets	92 0 0
India	78 10 0
Wire bars	67 15 0
Do. Oct.	67 10 0
Do. Nov.-Dec.	67 12 6
Ingot bars	67 10 0
H.C. wire rods	72 0 0
Off. av. cash, Sept.	61 18 11 5/11
Do., 3 mths. Sept.	62 18 2 3/11
Do., Sttlmnt, Sept.	61 18 0 9/11
Do., Electro, Sept.	67 18 2 3/11
Do., B.S., Sept.	65 14 2
Aver. spot price copper, Sept.	61 18 0¾
Do., wire bars, Sept.	68 2 6
Solid drawn tubes	13¼d.
Brazed tubes	13¼d.
Wire	10d.

BRASS.

Solid drawn tubes	12d.
Brazed tubes	13¼d.
Rods, drawn	11¼d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g	10½d.
Wire	10½d.
Rolled metal	9¾d.
Yellow metal rods	7¼d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£ s. d.
Standard cash	280 15 0
Three months	280 17 6
English	280 15 0
Bars	282 5 0
Straits	288 15 0
Australian	284 0 0
Eastern	289 5 0
Banca	288 5 0
Off. aver. cash, Sept.	259 3 8 7/22
Do., 3 mths., Sept.	261 0 0
Do., Sttlmt. Sept.	259 3 7 7/11
Aver. spot., Sept.	259 3 7½

SPELTER.

	£ s. d.
Ordinary	40 3 9
Remelted	37 10 0
Hard	31 15 0
Electro 99.9	44 5 0
English	40 17 6
India	32 15 0
Zinc dust	45 0 0
Zinc ashes	15 0 0
Off. aver., Sept.	37 1 6 9/22
Aver., spot, Sept.	37 8 8¼

LEAD.

	£ s. d.
Soft foreign ppt.	38 11 3
English	40 0 0
Off. average, Sept.	37 12 10 7/22
Average spot, Sept.	38 17 8

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	46 0 0
Do. V.M. ex whf.	45 0 0
Rods	52 0 0
Boiler plates	43 10 0
Battery plates	44 0 0

ANTIMONY.

	£ s. d.
Special brands, Eng.	74 10 0
Chinese	66 10 0
Crude	62 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	13 12 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon 45/50%	12 5 0
Ferro silicon 75%	21 0 0
Ferro-vanadium—35/40%	15/9 lb. va.
Ferro-molybdenum—70/75% c. free	6/3 lb.
Ferro-titanium—23/25% carbonless	1/1 lb.
Ferro-phosphorus, 20/25%,	£22 0 0
Ferro-tungsten—80/85%, c.fr.	1/8 to 1/8¼ lb.
Tungsten metal powder—98/99%	1/11 to 1/11½ lb.
Ferro-chrome—4/6% car.	£23 10 0
Ferro-chrome—6/8% car.	£23 10 0
Ferro-chrome—8/10% car.	£22 10 0
Ferro-chrome—Max. 2% car.	£40 10 0
Ferro-chrome—Max. 1% car.	£51 0 0
Ferro-chrome—Max. 0.70% car.	£56 10 0
Ferro-chrome—70%, carbonless	1/5 lb.
Nickel—99%, cubes or pellets	£170 to £175
Cobalt metal—98/99%	10/- lb.
Aluminium 98/99%	£120
Metallic Chromium—96/98%	3/9 lb.
Ferro-manganese (net)—76/80%, loose	£15 7 6
Ferro-manganese (net)—76/80%, packed	£16 7 6
Ferro-manganese (net)—76/80%, export	£15 5 0
Metallic manganese—94/96%, carbonless	2/- lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s. d.
Finished bars, 14% tungsten	2 6
Finished bars, 18% tungsten	3 6

Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. and over — 4d. lb.
Rounds and squares under ½ in. to ¼ in. — 3d. lb.
Do. under ¼ in. to 7/16 in. — 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in. — 3d. lb.
Do. under ½ in. × ¼ in. — 1/- lb
Bevels of approved sizes and sections — 6d. lb.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces — 3d.
Turningds andwarf — 1d.
Per lb. net, d/s steel makers' work

SCRAP.

	£ s. d. to £ s. d.
South Wales—Hvy. steel	3 7 6 to 3 10 0
Bundled steel & shrngs.	3 2 6 to 3 6 0
Mixed iron & steel	3 2 6
Heavy cast iron	3 5 0 to 3 7 6
Good machinery for foundries	3 10 0
Cleveland—Heavy steel	2 17 6
Steel turnings	1 17 6
Cast iron borings	1 15 0
Heavy forge	3 17 6
Bushelled scrap	3 0 0
Cast-iron scrap	3 2 0
Lancashire—Cast-iron scrap	3 10 0 to 3 12 6
Heavy wrought	3 5 0 to 3 7 6
Steel turnings	2 0 0

London — Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	53 0 0
Brass (clean)	40 0 0
Lead (less usual draft)	31 10 0
Tea lead	31 10 0
Zinc	27 0 0
New aluminium cuttings	92 0 0
Braziery copper	48 0 0
Gunmetal	47 0 0
Hollow pewter	188 0 0
Shaped black pewter	136 0 0

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—Foundry No. 1	69/6
Foundry No. 3	66/6
Foundry No. 4	65/6
Forge No. 4	65/-
Hematite No. 1	75/-
Hematite M/Nos.	74/6
N.W. Coast—Hem. M/Nos. d/d Glas.	84/-
„ d/d Birm.	92/6
Midlands—Staffs. common*	—
„ No. 4 forge	62/6
„ No. 3 foundry	65/6
Shrops. basic	70/-
„ Cold blast, ord.*	185/-
„ „ roll iron*	190/-
* d/d Birmingham.	
Northants forge	56/6
„ fdry No. 3	61/9
Derbyshire forge	59/3
„ fdry. No. 3	66/3
„ basic	65/-
Scotland—Foundry No. 1	84/-
„ No. 3	79/-
Hem. M/Nos.	78/6
Sheffield (d/d district)—Derby forge	61/6
„ fdry. No. 3	69/-
Lincs. forge	65/-
„ fdry. No. 3	67/6
E.C. hematite	85/-
W.C. hematite	87/-
Lincs. (at furnaces)—Forge No. 4	59/-
Foundry No. 3	61/6
Basic	65/-
Lancashire (d/d eq. Man.)—Derby forge	67/3
„ fdry. No. 3	73/6
Northants foundry No. 3	74/6
Dalzell, No. 3	110/-
Summerlee, No. 3	96/6
Glengarnock, No. 3	96/6
Gartsherrie, No. 3	96/6
Monkland No. 3	96/6
Coltness, No. 3	96/6
Shotts, No. 3	96/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d. to £ s. d.
Bars (cr.)	11 5 0 to 12 10 0
Angles	12 0 0
Tees to 3 united ins.	12 15 0
Nut and bolt	11 0 0
Hoops	14 0 0 to 15 0 0
Marked bars (Staffs.) f.o.t.	14 10 0
Gas strip	12 15 0
Bolts and nuts ¾ in. × 4 in.	16 15 0
Steel—Ship plates	8 0 0 to 8 12 6
Boiler plts.	11 10 0
Chequer plts.	£9 15 to 10 5 0
Angles	£7 5 0 to 7 15 0
Tees	£8 5 0 to 8 15 0
Channels	£7 2 6 to 7 12 6
Joists	£7 5 0 to 7 15 0
Rounds and Squares 3 in. to 5½ ins.	9 0 0
Rounds under 3 in. to ¾ in.	8 15 0
Flats, over 5 in. wide and up	9 10 0
Flats, 5in. to 1½in.	8 10 0
Rails, heavy	8 0 0
Fishplates	12 10 0
Hoops (Staffs.)	11 10 0
Black sheets, 24g.	11 5 0
Galv. cor. sheets, 24g.	16 5 0
Galv. fencing wire 8g. plain	14 0 0
Billets, soft	£6 0 0 to 7 10 0
Billets, hard	8 12 6
Sheet bars	£6 5 0 to 6 10 0
Tin bars d/d	£6 5 0 to 6 10 0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	4
Rods	1	3
Tubes	1	8½
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½

Wire round—3/0 to 10 G. 1/6½ to 2/1½ with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	22.26
No. 2 foundry, Valley	20.76
No. 2 foundry, Birm.	19.00
Basic	20.26
Bessemer	21.26
Malleable	20.76
Grey forge	20.26
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	2.00
Tank plates	1.80
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.40
Sheets, black, No. 28	3.10
Sheets, galv., No. 28	4.20
Sheets, blue an'l'd, 9 & 10	2.25
Wire nails	2.60
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplate, 100 lb. box	£5.50

COKE (at ovens).

Welsh foundry	37/6
„ furnace	27/6
Durham & North. foundry	33/- to 35/-
„ furnace	14/-
Other Districts, foundry	35/-
„ „ furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes, 20×14, box	19/9
„ 28×20, „	39/6
„ 20×10, „	29/4½
„ 18¾×14, „	20/9
C.W. 20×14, „	18/-
„ 28×20, „	36/-
„ 20×10, „	25/4½
„ 18¾×14, „	18/9

Terneplates 28×20, 36/4½ per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£19/0 to £20/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£10 to £14
Pig-iron	£6 15 0 to £7 0 0 all f.o.b. Gothenburg.

TUBES.

Up to and incl. 6 in.

Gas .. 55% } Tube prices
Water .. 50% } are
Steam .. 45% } now free.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Oct. 15	62	0	0	dec. 7/6
„ 16	62	0	0	No change
„ 19	62	0	0	„ „
„ 20	61	17	6	dec. 2/6
„ 21	61	15	0	„ 2/6

Electrolytic Copper.

	£	s.	d.	
Oct. 15	67	15	0	dec. 5/-
„ 16	67	10	0	„ 5/-
„ 19	67	10	0	No change
„ 20	67	10	0	„ „
„ 21	67	5	0	dec. 5/-

Standard Tin (Cash).

	£	s.	d.	
Oct. 15	280	0	0	inc. 20/-
„ 16	277	15	0	dec. 45/-
„ 19	279	15	0	inc. 40/-
„ 20	280	5	0	dec. 10/-
„ 21	280	15	0	inc. 10/-

Tin (English ingots).

	£	s.	d.	
Oct. 15	280	0	0	inc. 20/-
„ 16	277	15	0	dec. 45/-
„ 19	279	15	0	inc. 40/-
„ 20	280	5	0	dec. 10/-
„ 21	280	15	0	inc. 10/-

Zinc Sheets (English).

	£	s.	d.	
Oct. 15	46	0	0	inc. 20/-
„ 16	46	0	0	No change
„ 19	46	0	0	„ „
„ 20	46	0	0	„ „
„ 21	46	0	0	„ „

Spelter (ordinary).

	£	s.	d.	
Oct. 15	40	7	6	dec. 1/3
„ 16	40	0	0	„ 7/6
„ 19	40	2	6	inc. 2/6
„ 20	40	3	9	„ 1/3
„ 21	40	3	9	No change

Lead (English).

	£	s.	d.	
Oct. 15	40	5	0	No change
„ 16	40	0	0	dec. 5/-
„ 19	39	15	0	„ 5/-
„ 20	40	0	0	inc. 5/-
„ 21	40	0	0	No change

Exports of Iron Castings in September and the nine months, 1925 compared with September and the nine months, 1924.

	Sept., 1924.	Sept., 1925.	Nine months, 1924.	Nine months. 1925.	Sept., 1924.	Sept., 1925.	Nine months, 1924.	Nine months, 1925.
BUILDERS' CASTINGS:—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers:—								
To Argentine Republic	96	138	1,025	1,182	2,931	4,334	36,365	42,868
„ British South Africa	183	307	2,424	2,763	6,446	10,732	83,805	97,365
„ „ East Indies	74	118	981	1,299	2,815	4,956	41,764	59,499
„ Australia	93	42	591	525	4,816	2,316	33,024	29,530
„ New Zealand	156	158	1,490	2,027	8,154	8,415	72,601	94,614
„ Other countries	480	724	4,813	5,828	24,623	37,071	242,796	294,783
Total	1,082	1,487	11,324	13,624	49,785	67,824	510,355	618,659
PIPES AND FITTINGS—								
Cast—								
To Argentine Republic	492	726	5,979	9,128	7,834	10,218	82,309	117,385
„ British South Africa	188	342	5,784	5,197	3,300	5,514	74,902	74,305
„ „ India	762	637	8,860	7,391	11,158	9,934	131,281	105,504
„ Straits Sttlmts. & Malay States	917	231	7,699	4,455	10,409	2,794	96,235	53,086
„ Ceylon	40	96	744	997	728	1,107	10,339	12,422
„ Australia	305	186	3,378	2,415	5,935	3,798	53,051	39,018
„ Other countries	4,566	4,540	32,064	42,180	77,734	67,828	545,005	620,291
Total	7,270	6,758	64,508	71,763	117,098	101,193	993,122	1,022,011
HOLLOW-WARE—								
Cast, not Enamelled, & Cast, Tinned	594	696	4,871	6,162	24,001	24,403	195,697	207,465
„ Enamelled	105	70	819	749	9,509	7,450	84,044	77,300
CASTINGS, in the rough—								
Iron	127	50	1,132	1,120	5,633	2,147	46,731	39,349
Steel	68	83	1,994	557	3,699	3,307	37,953	22,722

WILLIAM JACKS & COMPANY,

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18, BENNETTS HILL, BIRMINGHAM.

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EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

1, HONG KONG ROAD, SHANGHAI.
OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
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P.O. BOX 1580, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 7 words per line. Minimum charge for one insertion 3/-.

SITUATIONS VACANT AND WANTED.

FOUNDRY FOREMAN, age 45, requires position; practical knowledge of Dry and Green Sand Castings; also experienced with Jar-ram and Squeezing Machines.—Box W. A. G., Offices of The Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2

FOREMAN MOULDER, Brass or Iron, seeks position; age 43 years; 15 years' experience as Foreman Moulder; Marine, Oil Engines, Hydraulic, Textile, Railroad, Crane and Mining Work; willing to go anywhere.—Box 468, Offices of The Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRY FOREMAN, disengaged, desires position; 22 years' experience; Engineering and Jobbing work; mix Grey Iron, Semi-steel, Non-ferrous Metals by analysis; can get maximum production and take charge of pattern shop.—Box 472, Offices of The Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRY TRADE TRAVELLER; disengaged; thoroughly practical in all branches of the Foundry Trade; member I.B.F.; connection Lancashire; age 34.—Box 458, Offices of The Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C 2.

EXPERIENCED ROLL FOUNDRY FOREMAN, in South Staffordshire district, to take complete charge of Roll Making, including Mixtures, Melting, Moulding and Casting of Chilled and Grain Rolls; must be qualified man, with good previous experience. References and wages required, experience and age to be stated.—Box 494, Offices of The Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

QUALIFIED FOUNDRY METALLURGIST, to control Chilled and Grain Roll Manufacture; must have good previous experience of all branches, including Mixture and Furnace Control. Details of previous experience, age and salary to be given.—Box 496, Offices of The Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

TRAVELLERS WANTED, calling on users of Hose-piping of all kinds, to carry quick-selling device of proved utility and vast possibilities; handsome commission; exclusive territory to right men.—Write:—Newton Sales Company, Ltd., Charterhouse Chambers, E.C.1.

PATENTS & TRADE MARKS.

PATENT YOUR INVENTIONS, Trade-mark your Goods. Advice, Handbook and Cons. free.—B. T. King, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.), 146a, Queen Victoria Street, E.C.4. 38 years' refs. 'Phone 682 Central.

AGENCIES.

A WELL-KNOWN GERMAN FOUNDRY MACHINE COMPANY, manufacturing in the first line Sand-blast Machines for all purposes, is desirous of appointing Agents in Great Britain on good conditions; firms in the Foundry Equipment line having own show rooms are preferred.—Applicants are invited to give full particulars to Box 504, Offices of The Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

TENDERS.

BOROUGH OF TAUNTON.

DUE to the Reconstruction of the Sewage Disposal Works the Taunton Town Council have for disposal second-hand Machinery, Cast-iron Pipes, Steel Joists, Drain Pipes, etc., for which they are prepared to receive Tenders.

The Lots include an Undertyped Marshal Compound Engine, 18-in. and 9-in. Centrifugal Pumps, 30-in. Cast-iron Pipes, etc.

Full information, together with Form of Tender, may be obtained from the undersigned, to whom offers for purchase should be made not later than 10 a.m. on Saturday, 31st October, 1925.

(Signed) Ivor F. Shellard, A.M.I.C.E.,
Borough Engineer and Surveyor.

Municipal Buildings,
Taunton,
16th October, 1925.

PROPERTY.

VERY old-established Malleable and Grey Iron Foundry for disposal, or would consider experienced gentleman with some capital to take complete management.—Write, in the first instance, to Box 506, Offices of The Foundry Trade Journal, Bessemer House, 5, Duke Street, London, W.C.2.

FOUNDRY AND ENGINEERING WORKS FOR SALE AS A GOING CONCERN.

OLD-ESTABLISHED BUSINESS, with well-equipped Shops, together with Freehold. General Castings up to 30 tons.

Apply:—

T. E. ROWELL, F.C.A.,
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FOR SALE.—20-in. and 24-in. Hall's Invincible Sand Mixers; the original and best machine in the market for mixing old and new Foundry Sand, Coal Dust, etc.—Apply, Penney & Porter (Eng.), Ltd., Lincoln.

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MACHINERY, PLANT, &c.

HORIZONTAL TANDEM COMPOUND ENGINE, 12½ in. and 20 in. cyls., 26 in. stroke, by Robey & Company.

VERTICAL COMPOUND OPEN TYPE ENGINE, by Browett Lindley, 15 in. and 22 in. cyls., 18 in. stroke.

SURFACE CONDENSING PLANT, by F. Pearn & Company, 10 in. and 16 in. steam cyls., surface area of tubes about 1,200 ft.

PAIR OF HORIZONTAL ENGINES, overhanging cylinders 16 in. diam. by 28 in. stroke, by Tangyes.

Two very good dished end LANCASHIRE BOILERS, by Thompson, 30 ft. x 8 ft., reinsure for 140 lbs. per sq. in. working pressure; ready for despatch.

Two LANCASHIRE BOILERS, 30 ft. x 7 ft. 6 in., now insured at 150 lbs. press.

Catalogue (6,000 lots) on application.

THOs W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

MACDONALD'S AJAX PNEUMATIC MOULDING MACHINES.—Two Second-hand wanted, with turnover No. 9 size, or similar machines of other make.—Write full particulars and where can be inspected, to A. W. & Co., Brass Dept., Elswick Works, Newcastle-on-Tyne.

MISCELLANEOUS.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—Cleghorn & Company, Midland Pattern Works, Spring Gardens, Worcester. Phone 264.

NEW CUPOLA

30" DROP-BOTTOM CUPOLA, by Constructional Co., **new and unused, £45, F.O.R. PORTON.**

LADLES—GEARED

30 Cwt. EVANS, New	£24
2 Ton EVANS	£28
5 Ton STEVENSON	£38

BUY FROM ME AND SAVE MONEY.

ALEX. HAMMOND,
FOUNDRY MACHINERY MERCHANT,
"BOXTED," SLOUGH.